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1.0 INTRODUCTION

1.1 The Clean Lakes Program

Section 314 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500)* directed the United States Environmental Protection Agency to assist the States in controlling sources of pollution which affect the quality of freshwater lakes, and in restoring lakes which have deteriorated in quality. EPA is fulfilling this mandate with the Clean Lakes Program, which provides technical and financial assistance to the States to:

1. Classify publicly owned freshwater lakes according to trophic condition;
2. Conduct diagnostic studies of specific publicly owned lakes, and develop feasible pollution control and restoration programs for them;
3. Implement lake restoration and pollution control projects.

Assistance is made available to the States through the EPA Regional Offices in the form of cooperative agreements. Because program funds are limited, and the number of publicly owned lakes with present or potential water quality problems is large, awards must be made selectively. Projects chosen for funding are those which maximize public benefits. Such projects meet three general criteria.

First, projected public benefits must be significant. A lake to be studied and restored or protected should be one which can provide beneficial uses to a large number of people.

Second, the water quality improvement must be long term, to insure lasting benefits. EPA will not support restoration measures which merely ameliorate symptoms of pollution in a lake. Instead, the Agency emphasizes watershed management — a comprehensive effort to identify and eliminate present or potential causes of lake water quality deterioration. Pollution is to be controlled at its source, not in the lake. When pollutant sources are being controlled, however,

in-lake restoration techniques to speed recovery are also eligible for funding.

Finally, projects should promote integrated, coordinated water quality management. Other Federal, State and local programs can supplement the Clean Lakes Program. For example, the 201 Construction Grants Program can complement a lake restoration agreement by helping municipalities eliminate pollution from domestic sewage. U.S. Department of Agriculture assistance is available to farmers to implement agricultural pollution control measures, supplementing Clean Lakes Program watershed management. Combining water quality management resources in this way enhances the effectiveness of expenditures under any single program.

1.2 Purpose of this Manual

The regulations governing the Clean Lakes Program became effective on February 5, 1980.* This manual has been prepared to guide the States in developing their own lake restoration and protection programs, in obtaining Federal Clean Lakes Program assistance, and conducting lake projects in accordance with those regulations. Policy, procedures, and technology are discussed, making this manual useful to State environmental and natural resources agency officials, whether their responsibilities are technical or administrative.

The manual is also intended to be used by other governmental agencies which may carry out lake projects under subagreements with the State. Watershed or lake associations and other groups of concerned citizens, who often initiate a lake project, will also find the manual useful. It will help them understand causes of lake problems and how to work with governmental agencies to solve them.

*Now known as the Clean Water Act of 1977 (P.L. 95-217).
 *40 CFR 35 Subpart H, reproduced in Appendix B to this manual.

1.3 Using the Manual

Section 2.0 describes the Clean Lakes Program, its history, and results. The section provides sufficient information for anyone with only a general interest in the program. For those who are or intend to become involved with the program, Section 2.0 should be treated as an introduction to the program regulations, "Cooperative Agreements for Protecting and Restoring Publicly Owned Freshwater Lakes" (40 CFR 35 Subpart H), reproduced in Appendix B.

Research and experience in limnology, lake restoration, and water quality management have produced a substantial body of useful scientific, technological, and institutional information. Much of it is reviewed in Sections 3.0, 4.0, and 5.0. Section 3.0 presents topics in lake ecology which are fundamental to an understanding of lake water quality management. Section 4.0 covers watershed management. Its content is supplemented by details on nonpoint sources and management practices found in Appendix C. Selected restoration techniques are the subject of Sections 5.0 and its corresponding Appendix D.

Sections 6.0 through 9.0 deal with the opportunities available through the Clean Lakes Program and the procedures which must be followed to take advantage of them. General program policy is the subject of 6.0. It should be required reading for State officials who administer lake restoration and protection programs; the information it contains on program strategy and goals and objectives is important to anyone developing State priority lists, preparing applications for funding, and coordinating lakes work with other environmental programs. Sections 7.0, 8.0 and 9.0 each cover a form of Clean Lakes Program financial assistance—State classification surveys, diagnostic-feasibility studies (Phase 1), and implementation (Phase 2), respectively. Each section discusses purpose, application procedures, review criteria, types of funding assistance, and project scope and conduct.

Two appendices are associated with Section 8.0 to assist with Phase 1 diagnostic-feasibility studies. Appendix E gives step-by-step instructions on fulfilling each requirement of a Phase 1 study. Appendix F covers cost-effectiveness analysis as it pertains to selection of lake restoration and pollution control measures from the list of alternatives developed in a Phase 1 study.

Physical, chemical, and biological monitoring of the lake and watershed is required in both Phase 1 and Phase 2. However, it is a topic of such importance and complexity that a separate section, 10.0, is devoted entirely to it. Purpose and design of monitoring programs, alternative methods of sample collection, and data analysis and interpretation are discussed. Appendix E, the Phase 1 protocol, contains procedural information on monitoring which is pertinent to both Phase 1 and Phase 2 projects and should be read in conjunction with Section 10.0. Section 11.0 provides a guide to other technical and financial assistance programs that can supplement or provide non-Federal matching funds for Clean Lakes projects. Local, regional, State and Federal programs are summarized in the section, and Appendix H describes these programs in detail.

Section 12.0 consists of Phase 1 and Phase 2 hypothetical case studies. The hypothetical applications included will serve as models to assist States in applying for cooperative agreement awards.

Four other appendices have been included. Appendix A is a glossary of specialized terms used in lake and watershed management. Appendix G contains instructions and suggested formats for reporting water quality monitoring and baseline data, and administrative information to EPA. Appendix I contains guidance on selecting consultants. Appendix J is a list of references used in preparing the manual or recommended as sources of additional information.

1.4 Updates and Revisions

This manual has been produced in loose-leaf form so that it can be easily amended. EPA plans periodic updates to reflect advances in the state-of-the-art and changes in Clean Lakes Program regulations.

Because the manual was prepared to be of practical use to all participants in the Clean Lakes Program, EPA would like to receive any suggestions for changes which would improve its usefulness. The best source of such suggestions is feedback from the users themselves. You are encouraged to submit comments and recommendations to:

Chief, Clean Lakes Section (WH-585)
U. S. Environmental Protection Agency
Washington, D.C. 20460

2.0 THE CLEAN LAKES PROGRAM

This section summarizes the Clean Lakes Program — its legislative basis, regulations, program description, application procedures, and results to date.

2.1 Legislative Basis

Section 314 of the Clean Water Act of 1977 is the legislative basis for the Clean Lakes Program.

SEC. 314.

(a) Each State shall prepare or establish, and submit to the Administrator for his approval —

(1) an identification and classification according to eutrophic condition of all publicly owned freshwater lakes in such State;

(2) procedures, processes, and methods (including land use requirements), to control sources of pollution of such lakes; and

(3) methods and procedures, in conjunction with appropriate Federal agencies, to restore the quality of such lakes.

(b) The Administrator shall provide financial assistance to States in order to carry out methods and procedures approved by him under this section. The Administrator shall provide financial assistance to States to prepare the identification and classification surveys required in subsection (a)(1) of this section.

(c)(1) The amount granted to any State for any fiscal year under this section shall not exceed 70 per centum of the funds expended by such State in such year for carrying out approved methods and procedures under this section.

(2) There is authorized to be appropriated \$50,000,000 for the fiscal year ending June 30, 1973; \$100,000,000 for the fiscal year 1974; \$150,000,000 for the fiscal year 1975; \$50,000,000 for the fiscal year 1977; \$60,000,000 for the fiscal year 1978; \$60,000,000 for the fiscal year 1979; and \$60,000,000 for the fiscal year 1980 for grants to States under this section.

These sums shall remain available until expended. The Administrator shall provide for an equitable distribution of such sums to the States with approved methods and procedures under this section.

2.2 Program Regulations

Rules and regulations governing "Cooperative Agreements for Protecting and Restoring Publicly Owned Freshwater Lakes" became effective February 5, 1980 as Subpart H to Part 35 of Title 40 of the Code of Federal Regulations. They cover all aspects of the Clean Lakes Program in detail except for State lake classification surveys, which were described in a notice of availability of grants assistance published July 10, 1978 in the *Federal Register*. Both of these documents have been reproduced as Appendix B to this manual.

2.3 Overview of the Program

2.3.1 Goals

The goal of the Clean Lakes Program is to implement, through assistance to the States, methods and procedures to control sources of pollution to the Nation's publicly owned freshwater lakes and to restore degraded lakes. Recognizing, however, that this applies to all publicly owned lakes and several thousand may need immediate action, the program has established a more specific goal for the 1980-1985 period. The goal is to protect at least one lake whose water quality is suitable for contact recreation, or to restore a degraded lake to that condition, within 25 miles of every major population center. A population center, in this context, usually is a Standard Metropolitan Statistical Area (SMSA) as defined by the U.S. Bureau of the Census. However, this definition will be applied with discretion in selecting projects for funding. Some SMSAs are so populous that a single clean lake would not be sufficient to meet user demand.

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Conversely, in SMSAs near the ocean beaches, bays, large rivers, or the Great Lakes, there may be little demand for lake protection or restoration. In vacation and tourist areas where seasonal populations are high, and in other situations where lake water quality is important to regional economy and quality of life, projects may warrant priority equal to that accorded urban lakes. More explicit guidance on this aspect of project selection will be developed, but the need for flexibility will never be eliminated.

2.3.2 Objectives

To ensure that all program activities are oriented toward attaining the 1985 goal, EPA has set five specific objectives:

1. Select projects to maximize public benefits;
2. Integrate program with other environmental and water quality programs;
3. Emphasize watershed management;
4. Develop active State involvement and maintain Federal-State partnership;
5. Conduct continuous program and project evaluation.

EPA will manage the Clean Lakes Program in accordance with these objectives, attempting in each decision to achieve as many as possible. From the standpoint of the States, this policy will insure that the projects selected for cooperative agreement awards will be those which most completely embody the five objectives. Consequently, States should use them in managing their own programs and preparing applications for Section 314 assistance. Each objective is discussed in more detail in Section 6.0 of this manual.

2.3.3 Types of Financial Assistance Available

The Clean Lakes Program operates through three types of cooperative agreements.

State Lake Classification Survey. States that wish to participate in the Clean Lakes Program must submit to EPA by January 1, 1982, a classification, according to trophic condition, of publicly owned freshwater lakes in need of restoration or protection. Not all publicly owned lakes need be surveyed, but survey results for priority lakes and the procedure used to select these lakes must be presented. States will not be eligible for Phase 1 or 2 Federal financial assistance until they have complied with this requirement. Funding assistance equal to 70 percent of the cost, up to a maximum of \$100,000, is available. Section 7.0 of this manual is devoted to Lake Classification Surveys.

Phase 1 — Diagnostic Feasibility Study. The Clean Lakes Program will financially assist a State in conducting a diagnostic-feasibility study

to investigate the existing or potential causes of decline in a publicly owned lake's quality, evaluate possible solutions to existing or anticipated pollution problems, and recommend the most feasible program to restore or preserve the quality of the lake. Funding assistance equal to 70 percent of the cost is available, up to a maximum of \$100,000 per study. Section 8.0 of this manual discusses Phase 1 studies in detail.

Phase 2 — Implementation. A Phase 2 cooperative agreement is to be used for implementing recommended methods and procedures for controlling pollution entering the lake, and for restoring the lake. Phase 2 awards require a 50 percent non-Federal share, but this can often be made up in services-in-kind. Costs for final engineering design as well as actual implementation of pollution control and/or in-lake restoration measures are eligible. Phase 2 agreements follow Phase 1 studies or equivalent investigations. However, initiation of Phase 2 is not automatic; each phase must be applied for separately, and each application is considered on its own merits. Section 9.0 provides more details concerning Phase 2 projects.

2.3.4 Eligibility for Assistance

States are the only eligible applicants for Clean Lakes Program assistance. Cooperative agreements will be awarded to the State agency designated by the governor. However, a State may in turn make funds available to a substate agency for all or any portion of a specific project.

For a project to be eligible, the lake concerned must be freshwater and nontidal. It may be natural or manmade, but it must have recreational value and be accessible to the public by way of publicly owned land. If fees are charged for public use, they must be for maintaining recreational facilities or managing water quality on publicly owned lakes in the State.

2.3.5 Application Procedure

Clean Lakes Program cooperative agreements are administered at the EPA Regional Office level. States should submit applications to the appropriate Regional Office for review by the water division staff. Applications are also reviewed at EPA Headquarters and, in the case of Phase 2 projects, are sent to the U.S. Department of the Interior Fish and Wildlife Service, EPA's Environmental Research Laboratory at Corvallis, Oregon, and to two peer reviewers (a group of lake restoration and protection experts selected for this purpose). Based on these reviews, award decisions are made in the Regional Office.

Figures 2-1 and 2-2 are flow diagrams of the application and review process. Sections 7.0, 8.0, and 9.0 discuss application and review procedures for each of the three types of cooperative agreements.

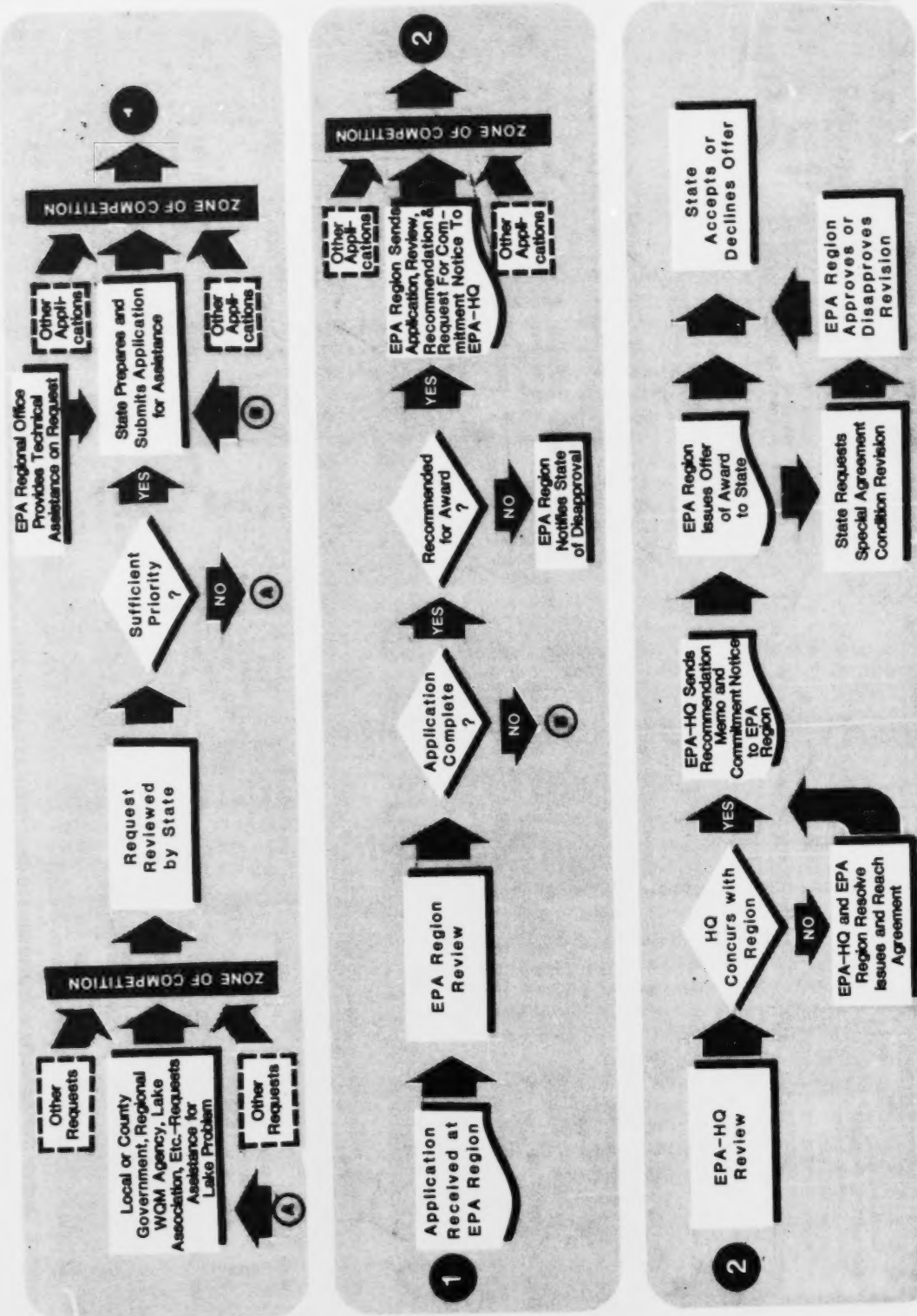


Figure 2-1. Cooperative Agreement Application Process: Classification Surveys and Phase 1 Studies.

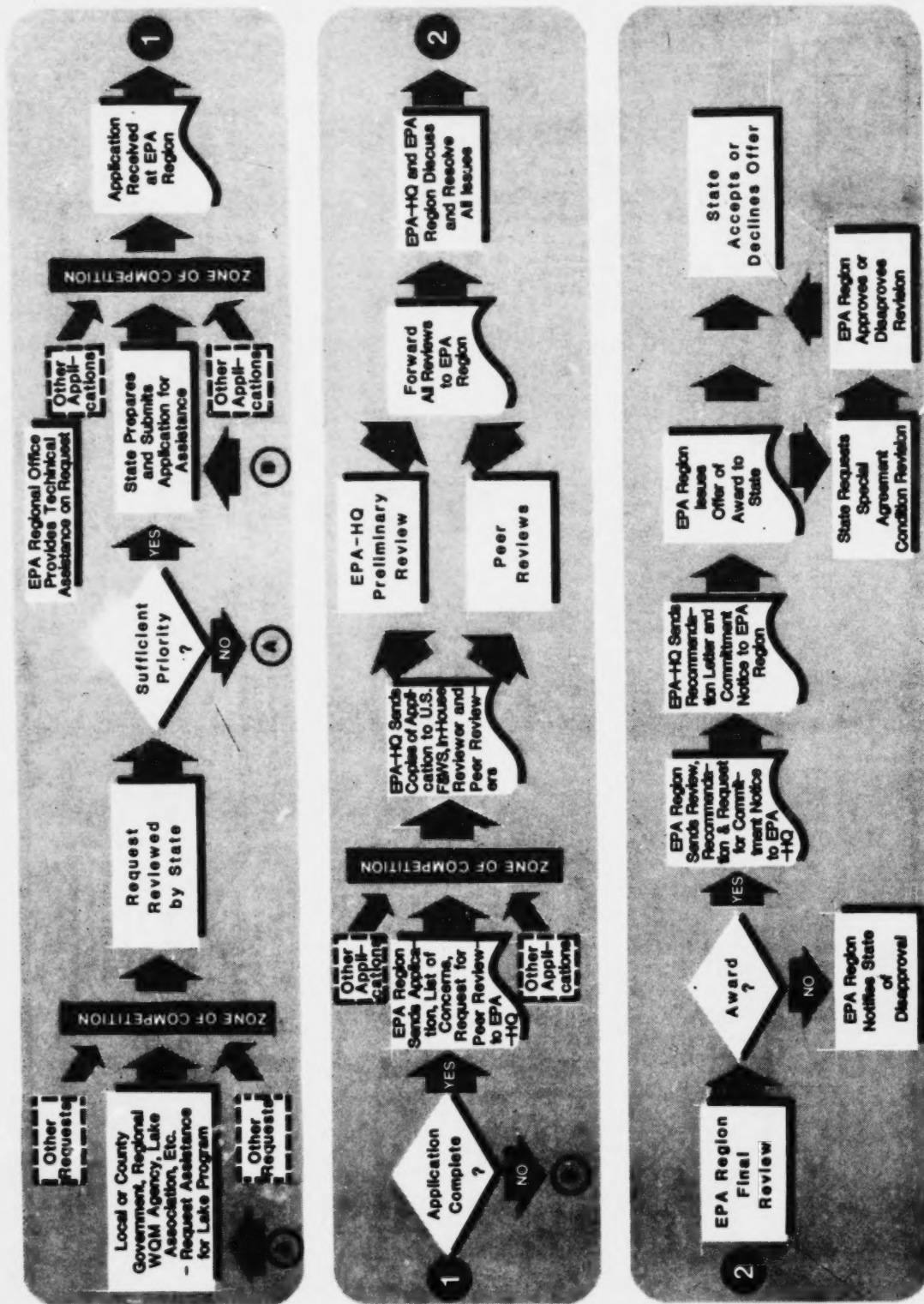


Figure 2-2. Cooperative Agreement Application Process: Phase 2 Implementation Projects.

2.3.6 Application Review

Phase 1 and Phase 2. When reviewing applications, EPA and outside reviewers apply nine specific criteria.

1. Technical feasibility;
2. Lake ecosystem improvements anticipated;
3. Fish and wildlife habitat improvements anticipated;
4. Extent of public benefits;
5. Consideration of open space policies of the Clean Water Act [Sections 201(f) and (g), 208(b)(2)(A)];
6. Reasonableness of costs;
7. Means for controlling adverse environmental impacts*;
8. State priority ranking;
9. Proposed operation and maintenance program.

In addition, compatibility with the five objectives listed in 2.3.2 are assessed during the review process.

2.3.7 Limitations and Conditions on Awards

There are certain restrictions on the Regional Administrator's ability to award a cooperative agreement to a given State, regardless of the technical merits of the application. Some are administrative, to encourage intergovernmental cooperation and coordination among various water quality programs, and to avoid expenditures on ineligible items. Others are technical, to eliminate from the Clean Lakes Program types of lake restoration activities which do not contribute to attaining the overall objectives (40 CFR 35.1650-2).

1. State lakes programs must be incorporated in State-EPA Agreements (SEAs).
2. Phase 2 must implement the recommendations of Phase 1, or a similar diagnostic-feasibility investigation.
3. Other authorized, planned, or ordered control measures for pollution sources affecting the lake (i.e. under sections 201, 208, and 402 of the Clean Water Act) must be implemented on schedule.
4. No costs for controlling point sources subject to control under Sections 201 and 402 may be included.
5. The Act's open space policies must be considered in any wastewater management activities the State is implementing in the watershed.
6. Palliative approaches, such as weed harvesting, chemical treatment, or aeration, cannot be funded unless they are the most cost-effective or energy-efficient restoration approaches, and unless pollution

sources in the watershed have been controlled as much as is practicable.

7. Costs may not be included to desalinate normally saline lakes, purchase or lease land solely to provide public access, carry out activities resulting from litigation against the recipient by EPA, or implement environmental impact mitigative measures not identified in the work plan.

Awards are made subject to certain general conditions (40 CFR 35.1650-3). For all types of assistance, the States must accept responsibility for payment of the non-Federal share of project costs. In the case of Phase 1 studies, there are three additional conditions.

1. The EPA Project Officer must approve the State's program to provide physical, chemical, and biological data on the lake before the State can begin other work.
2. Before selecting the best plan for lake restoration or protection, the State must submit an interim report to the EPA Project Officer, including an evaluation of alternatives and a summary of public involvement.
3. The EPA Project Officer must approve the selected plan before additional work can proceed.

Phase 2 projects are subject to the following conditions:

1. The monitoring program must be approved by the EPA Project Officer before any other work begins.
2. The State must maintain all control measures throughout the duration of the project, and any equipment purchased for at least its depreciable life.
3. If higher water uses are achieved by the project, State standards must be upgraded to reflect this fact.
4. Mitigation measures for primary adverse environmental impacts must be included in the project.
5. In accordance with the National Historic Preservation Act, work shall be stopped or work plans modified to protect any unrecorded archaeological sites encountered.
6. Wherever Section 404 permits are required, the State shall obtain them before beginning work.

Other project-specific conditions may be included in cooperative agreements when appropriate.

2.4 Program Results

Since the first Clean Lakes project began in 1975, 200 awards have been made, totalling \$60 million in Federal funds. There are currently 35 classification surveys, 71 Phase 1 Diagnostic-Feasibility Studies, and 105 Phase 2 projects in progress. Clean Lakes projects are distributed over 43 States.

*Not considered for Phase 1 applications.

A recent study (JACA Corp., 1980) of 28 of the older implementation projects showed that the program is producing public benefits in 12 categories: recreation, aesthetics, flood control, economic development, fish and wildlife, agriculture, public health, commercial fishing, water supply, education and research and development, pollution reduction, and miscellaneous items such as resource recovery and reduced

management cost. Expressing in monetary terms those benefits which could be so measured showed a return of more than \$8 for each Federal dollar expended, or over \$4 per total project dollar. In addition, the program seemed to be almost universally popular with those who had participated in it, and in many cases, projects funded under it had stimulated other community improvement activities.

3.0 LAKE AND RESERVOIR ECOLOGY

3.1 Introduction

The purpose of this section is to provide an understanding of some basic properties of lakes, emphasizing factors which affect water quality. It is intended as an introduction to limnology for readers with no background in this subject, but it may also be useful as a review to readers with some experience in lake studies.

3.2 Characteristics and Classification of Lakes

The lakes and reservoirs of the United States are diverse. They occur in many shapes and sizes and in a wide variety of landscapes. The chemical compositions of their waters range from very soft, comparable to rainwater, to dense brines which are many times more concentrated than seawater. Some lakes are darkly stained by leachate from vegetation or soils, while others are clear. Hydrology is also quite variable: in some lakes the volume of water is replaced rapidly, every few days or so, but at the other extreme, water replacement in some large, deep lakes takes centuries. In terms of biological condition, lakes range from nearly sterile environments to systems which produce much plant and animal life. A wide variety of intermediate conditions of productivity can be found, along with a great diversity of plant and animal communities. Lakes are heterogeneous, and because of this it is difficult to make generalizations about them.

The development of lake classification schemes played a prominent role in the early stages of modern limnology, as scientists attempted to organize their knowledge about lakes. Limnologists have classified lakes according to all major physical, chemical, and biological properties, as well as their origins. Such schemes help categorize our knowledge of lakes, and they often provide a conceptual framework for developing theories on the behavior of lakes

as systems. From a practical viewpoint, classification schemes are useful in identifying and describing lakes, because a given category calls to mind a variety of properties that a lake is likely to have. Nonetheless, it should be kept in mind that classifications are not ends in themselves but are meant to serve as useful organizing tools.

3.2.1 Origins of Lake Basins

Natural lakes are formed both by sudden events and by gradual processes that act over the course of centuries. Hutchinson (1957), who presented the most thorough modern analysis of the ways that lakes are formed, divided these formative processes into 76 categories within 11 major classes. The most important classes for U.S. lakes are described in Table 3-1.

3.2.2 Trophic State of Lakes

Limnologists classify lakes according to their biological productivity as measured by physical, chemical, and biological parameters. The lakes with the lowest concentrations of plant nutrients, and hence with the lowest levels of biological productivity, are called "oligotrophic" (oligo means "few" or "scant" and trophic refers to food). In contrast, eutrophic lakes have high levels of plant nutrients, and as a result have high levels of biological productivity. Lakes with characteristics between oligotrophic and eutrophic are called mesotrophic. The term ultraoligotrophic is sometimes used for lakes on the lowest extreme of the scale while the term hypereutrophic is used for the other extreme.

In actual practice there is a continuum in lake types, so that these separations are artificial. It is only recently that quantitative criteria have been proposed for each category. It should be emphasized that within a classification such as eutrophic, there is a broad range in water quality from those lakes with the highest levels of productivity to those with the lowest. For this reason, quantitative measures of trophic state are need-

Table 3-1
Major Processes Involved in the Formation of Lake Basins

Process	Comments	Examples
Tectonic	Formed by movements of the earth's crust: slow uplift, earthquakes, faulting, and tilting of fault blocks.	L. Okeechobee, Fla. L. Tahoe, Calif./Nev.
Glacial	Formed by ice scour of rock basins, by damming of valleys by glacial deposits, or by melting of large, isolated ice blocks in glacial deposits.	Michigan and most lakes in Wis., Minn., Mich.
Volcanic	Formed in craters of extinct volcanoes, in depressions of irregular lava flows, or by lava damming a valley.	Crater L., Oreg. Yellowstone L., Wyo.
Solution	Formed directly by carbonation and solution of limestone by percolating groundwater and/or subsequent collapse of gradual settling of ground, forming sinkholes.	Many lakes in peninsular Fla.
Fluvial	Formed by action of flowing waters.	Oxbow lakes along major rivers.
Manmade	Reservoirs formed by damming rivers causing water to fill a valley, excavation lakes dug to obtain minerals (limestone, phosphate) or fill to build up adjacent low lands.	L. Mead, L. of the Ozarks, limestone quarries, phosphate pit lakes, borrow pit lakes, millponds.

Source: Adapted from Hutchinson, 1957.

ed to characterize a lake.

The past histories of lakes have been studied by examining sediment cores for chemical composition and the remains of plants and animals. These studies have shown many lakes that were initially oligotrophic have become eutrophic through time (hundreds or thousands of years). The term eutrophication was used to describe this change in trophic state. For some time it was thought that this process was an inevitable, one-way change like ecological succession in terrestrial environments; however, it is now known that this is not the case. A brand new lake in a region with high nutrient concentrations in runoff will be eutrophic from the start, while some very old lakes have been shown to change their trophic state back and forth between oligotrophic and eutrophic in response to changing environments. It has also been found that lakes can undergo very rapid eutrophication in response to man-caused increases in nutrients and sediments. For example, Lake Erie has undergone changes in trophic state, such as increased plankton populations, decreased water transparency, more severe oxygen reductions in the hypolimnion, and changes in fish species composition, in a period of a few decades rather than centuries. This rapid, man-caused change is often called cultural eutrophication.

The trophic state of a lake is determined by a large number of factors including latitude, altitude, climate, watershed characteristics, soil types, human activities, and lake morphometry. Three broad factors seem to be most important. These are climate, nutrient supply, and lake depth. Lakes in cold climates tend to be less pro-

ductive due to colder temperatures and a shorter growing season; other things being equal, warmer climates promote more eutrophic conditions. Mean depth (ratio of lake volume to lake surface area) is an extremely important physical variable in determining trophic state. In general, the most oligotrophic lakes are also the deepest — Lake Superior and Lake Tahoe, for instance — and the very eutrophic lakes tend to be quite shallow. While depth plays some role in holding down summer temperatures in the deepest lakes and thus reducing the rate of biological production, its greatest effect seems to be in reducing nutrient concentrations. Whether a given nutrient comes from surface runoff, point source pollution, or diffusion from the bottom sediments, the greater the mean depth of a lake, the greater the nutrient dilution.

Recent quantitative studies have confirmed long-held ideas that the amount of plant biomass in a lake during the summer peak is determined by the quantity of nutrients available. It has also been found that for most lakes phosphorus is the limiting element. However, nitrogen is sometimes limiting, more often in the Western United States than in the East. Experiments with pristine Canadian lakes have shown that an oligotrophic lake can be almost immediately changed into a eutrophic lake by adding inorganic phosphorus and nitrogen fertilizers and that it rapidly reverts to the oligotrophic state if the fertilizer supply is cut off. This confirms other studies that show that a continuous supply of phosphorus and nitrogen is necessary to maintain the concentrations of those elements in the water column. Sediments release some nutri-

ents, but in the long term more materials move to the sediments than come out; the sediments thus serve as net nutrient traps rather than sources. An exception would be where nutrient input has significantly decreased. In this case there may be a net movement of nutrients back to the lake water, particularly in shallow lakes or in lakes that had received heavy nutrient loading from sewage effluents for a long period of years. Dredging is sometimes used to remove such nutrient-rich sediments to reduce this backflow.

In the course of a lake's history, the three broad factors — climate, nutrient supply, and depth — interact to determine lake trophic state. Since most particulate materials will not leave a lake basin once they have entered, the mean depth steadily decreases. The rate of change will vary from lake to lake depending upon such factors as the erodibility of the soil, the amount of runoff, and the ratio of watershed area to lake surface area. Other things being equal, the continuing loss of lake depth will lead to more eutrophic conditions because the dilution capacity diminishes. Climate, however, may change during the life of a lake with consequent changes in lake temperatures, wind mixing, and runoff amounts that may influence the trophic state. Nutrient inputs may also change, and not necessarily in a predictable manner. For example, in the life of a glacial lake basin, the nutrient inputs may change as the raw glacial till is developed into a mature soil profile under the influence of climate and vegetation. Human activities in the watershed may make significant changes in the nutrient input and hence the trophic state of lakes.

3.2.3 Lake Stratification

Many lakes experience thermal stratification. In its simplest form, it consists of a layer of warm, relatively light water at the surface and a cold and dense layer on the bottom, separated from each other by a transition layer with a strong temperature gradient. Limnologists call the upper layer the "epilimnion," the middle layer the "metalimnion" (thermocline in older terminology), and the bottom layer the "hypolimnion." The density gradient in the metalimnion prevents the waters of the epilimnion from circulating any deeper, thus sealing off the hypolimnion from the lake surface.

In the northern temperate regions, say Minnesota or Michigan, most deep lakes have two periods of circulation per year and thus are called "dimictic." In a typical cycle the lake is unstratified in the early spring just after the ice has melted. Water temperatures are uniform from surface to bottom, and wind energy sufficient to completely mix the lake in what is called the "spring turnover." Dissolved salts and gases are evenly distributed throughout the water col-

umn. As the season progresses, solar radiation causes the surface water to warm more rapidly than the underlying water, and the resulting temperature gradient produces a density gradient that resists vertical mixing. A typical thermal stratification is produced, with a well-mixed epilimnion but a more or less stagnant metalimnion and hypolimnion. (Figure 3-1)

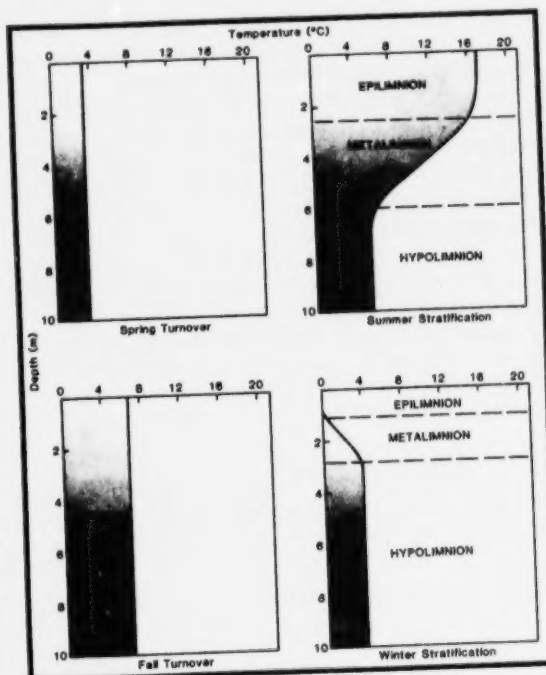


Figure 3-1. Thermal Stratification and Turnover in Lakes.

With cooler weather in the fall, the lake begins to lose heat and surface temperatures drop. The wind is able to mix the lake progressively deeper and the density gradient weakens. Eventually the metalimnion erodes and the entire lake circulates in the "fall turnover." The lake is now completely mixed again.

The second stratification in the annual cycle of a dimictic lake occurs because of a peculiar property of water — it is most dense at 4° C. When cooled below that temperature, its density decreases. Thus when the lake freezes or approaches freezing, an inverse stratification can develop with warmer water at the bottom.

The above pattern is modified in both colder and warmer climates. In the far north or at very high altitudes the ice may not melt until mid-summer, and there is a short circulation period following by refreezing. These lakes are called cold monomictic because they circulate only once a year. In contrast, in the southern United States where lakes do not freeze, the fall turnover is merged with the spring turnover into one

long period of circulation. These lakes are called warm monomictic. Shallow lakes and lakes protected from the wind may not stratify at all.

The significance of stratification in eutrophic lakes is that no exchange of dissolved gases, such as oxygen and carbon dioxide, is possible between the hypolimnion and epilimnion. During the summer, organic material produced in the epilimnion settles into the hypolimnion and bottom sediments where it is decomposed by biological action. Dissolved oxygen is consumed in the decomposition process and cannot be replaced; light usually cannot penetrate sufficiently deep in a eutrophic lake to permit photosynthesis and the accompanying release of oxygen takes place in the hypolimnion. It is not uncommon for complete oxygen depletion to develop during summer stratification. When it does, it persists until fall turnover.

Oxygen depletion may also occur under the ice in eutrophic lakes which stratify in the winter. Decomposition and respiration continue to consume oxygen, while light penetration, and thus photosynthesis, are reduced by ice and snow. Shallow lakes with heavy snow cover are particularly susceptible.

3.2.4 Biological Communities of Lakes

The biota of lakes are organized through two fundamental natural properties: the flow of en-

ergy from the sun through food webs, and the cycling of nutrient elements (e.g., carbon, nitrogen, phosphorus, iron, sulfur) that form organisms and organic matter.

Plants and animals are described and categorized by their functions in food webs. Algae and macroscopic plants absorb sunlight and convert the light energy into the chemical energy contained in the organic molecules (sugars, proteins, fats, and other cellular constituents) that they manufacture through photosynthesis. Plants form the base of a complex web of food and energy transfers among groups of organisms labeled herbivores (plant feeders), carnivores (animal feeders), omnivores (plant and animal feeders), and detritivores (organisms that consume nonliving organic matter). The food web also is sometimes divided into producers (plants), consumers (zooplankton, other invertebrates, and fish), and decomposers (primarily bacteria that complete nutrient cycles by converting dead organic matter back into inorganic forms).

Energy is derived by the consumers and decomposers from the oxidation of organic matter to carbon dioxide, water, and other inorganic substances via the oxygen-consuming process of respiration. The energy derived from respiration by organisms is used for their maintenance, activity, and growth. There is a one-way flow of energy through the food web — energy, in the form of unusable heat, is dissipated at each step in the oxidation process. However, the elements that comprise the organic matter in the food web can be reused. Nutrient cycles convert elements from inorganic to organic forms and back again; the study of nutrient cycles is an important part of aquatic ecology.

Some nutrients, such as nitrogen and carbon, have complex cycles that include volatile and gaseous compounds and thus involve atmospheric, as well as terrestrial and aquatic phases. Other essential elements, such as phosphorus and potassium, have no volatile forms, and their cycles involve living and nonliving forms in the soil and water. The availability of these elements depends on such processes as weathering of rocks and minerals, whereas volatile elements may be abundant and readily available in the atmosphere.

The food web of a lake (Figure 3-2) can be divided into two parts: the littoral (shallow) system and the pelagic (deep water) system. The littoral food web occurs in the shallow, near-shore area, and its primary producer component is dominated by rooted macrophytes ("aquatic weeds"), including emergent, submergent, and floating varieties. The littoral community receives the inflow from streams and stormwater runoff; soil, leaves, and other land-based pollutants tend to accumulate in this area. The domi-

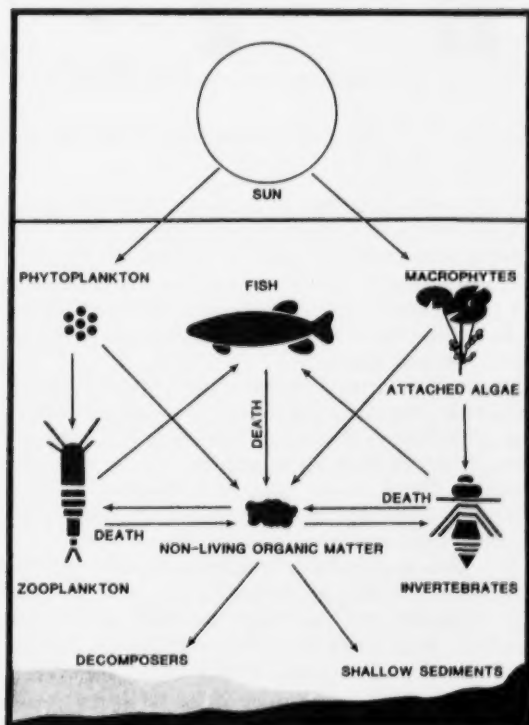


Figure 3-2. Lake Food Web.

nant energy pathway of the littoral food web is the detritivore food chain; the macrophytes tend not to be consumed directly (except by waterfowl and terrestrial animals only partially dependent on the aquatic food web), but die and their dead organic matter (detritus) is then consumed. The littoral and pelagic food webs are interconnected in two principal ways. First, some of the dead macrophyte matter is transported to the open (deep) water by currents and wave action. There it is decomposed, and the nutrients that are released stimulate growth of planktonic algae. Second, the littoral zone serves as a source of food and as a spawning area for fish that also inhabit the open water areas.

In the deep open water, phytoplankton (planktonic algae) are the base of the food web. Zooplankton (microscopic animals) and small fish graze on the algae, and in turn the zooplankton are grazed by fish. Death and settling of the remains of food web organisms into the bottom sediments act as a net loss of nutrients from the open water. The cycle is closed by release of soluble nutrients to the overlying water during decomposition. This process is not complete, however; lakes act as net nutrient sinks, storing through sediment accumulation.

Littoral vegetation is desirable for several reasons. It serves as a spawning area for fish and as a food source and refuge for small fish. Moreover, the littoral vegetation is a buffer between the open water planktonic algae system and the land (and nutrient inputs from the watershed). In the absence of littoral vegetation, a lake is likely to have higher concentrations of algae, lower water clarity, and fewer game fish. The abundance of littoral vegetation is related to the amount of shallow water and the light that reaches the bottom sediments in the shallow areas. In lakes with high nutrient inputs, aquatic weeds can grow to excessive proportions and be a severe nuisance to swimmers and boaters. In other lakes, nutrient enrichment leads to an increase in algae, which decrease water clarity, leading to a loss of littoral vegetation.

Predicting which type of plants (macrophytes or algae) will dominate in a given lake is difficult, but the trend usually is unidirectional and not easily reversed. Once algae dominate a lake, the intense shading they cause tends to prevent the reestablishment of littoral vegetation. Incoming soil turbidity, motor boat disturbances in shallow lakes, and activities of bottom-feeding fish can transform a lake from a macrophyte-dominated to an algae-dominated system.

3.2.5 Physical, Chemical, and Biological Conditions in Lakes

By now it should be apparent that the physical, chemical, and biological characteristics of lakes are related so intimately that a change in one will surely lead to changes in the other two. For example, a chemical factor such as increased plant

nutrients increases algal populations (a biological factor) which in turn increases turbidity and reduces light penetration (physical factor). The importance of understanding this interrelationship cannot be overstressed, because the concept is critical for effective lake management.

As previously noted, oligotrophic lakes are usually characterized in the following manner:

1. Low nutrient concentrations;
2. Low biological productivity;
3. Clear water;
4. Dissolved oxygen throughout the water column.

In eutrophic lakes, these features are just the opposite, and mesotrophic lakes would be somewhere in between. One should remember, however, that all lakes, especially eutrophic lakes in northern climates, exhibit considerable seasonal variation. The worst problems associated with eutrophication (odors, fish kills, dense growths of vegetation, etc.) usually occur during warm weather months. In cold weather, the most eutrophic lakes may resemble mesotrophic or even oligotrophic water bodies, as low light intensities and low temperatures slow down biological processes. Under heavy snow cover, however, low light intensities may cause photosynthetic oxygen production to be lower than the oxygen consumption by decaying plant materials. This can result in a complete loss of dissolved oxygen, and fish kill, particularly in shallow lakes.

During summer months, the surface waters of highly eutrophic lakes are turbid and may smell of decaying organic matter. Filamentous algae and aquatic plants such as water milfoil (*Myriophyllum*), various pondweeds (*Potamogeton* sp.) and *Anacharis* often form tangled mats of vegetation across the surface, thus limiting the use of the lake for boating and swimming. Algal mats or dense blooms of phytoplankton diminish or destroy the appearance of lakes, but more important are numerous species that cause taste and odor problems in drinking water: certain blue-green algae, for example, impart a musty odor to water. Other algae emit toxic substances that may kill other forms of aquatic life.

These are not the only problems aquatic vegetation causes. Dense growths of rooted aquatics or algae can cause daily fluctuations in the concentration of dissolved oxygen: during daylight hours at the height of the growing season, surface water often becomes saturated and sometimes supersaturated with dissolved oxygen given off by green plants; however, at night when no oxygen is being produced, respiration by aquatic plants and animals can deplete the supply sufficiently to cause a fish kill. Even a series of warm cloudy days may be enough to reduce dissolved oxygen to undesirable levels and cause poor water quality.

Low species diversity and high biomass are common features of eutrophic lakes. Poor water quality has much to do with this; many sensitive species are eliminated or greatly reduced when water quality conditions become unfavorable. Almost always, however, a few more tolerant species become abundant because of lack of competition or predator pressure. Thus, eutrophic lakes support unbalanced communities characterized by large numbers of a relatively few species. Energy becomes blocked in lower levels of the food web instead of flowing smoothly through it, because many of the algae and rooted aquatic plants found in highly eutrophic lakes are also the ones least favored by plant-eating animals.

The interrelationships of physical, chemical, and biological processes are also responsible for nutrient recycling, one of the most difficult problems to deal with in lake management. As Hutchinson (1969) points out, the biological characteristics of a lake appear to result only partly from the nutrient supply contained in its water; the total potential supply of nutrients in the lake system is more important than the concentration at any given time. Concentrations of nitrogen, phosphorus, and other nutrients dissolved in lake water will be low if most of the supply is locked up elsewhere in the system. Besides the water column, nutrients may be stored in plant and animal tissue or in the bottom sediments. What makes their elimination or reduction so difficult in lake management is that during one season of the year they may be predominantly in one location (i.e., tied up in living tissue) and in another, elsewhere (i.e., the bottom sediments).

In some lakes, recycling is responsible for maintaining high nutrient concentrations even when external sources are eliminated. Limnologists have shown that phosphorus, which of all the nutrients is the one most likely to be in shortest supply in freshwater lakes, is in constant flux. In surface waters with both an abundance of phytoplankton to take up the phosphorus and large numbers of decomposing organisms (bacteria and fungi) to decay dead tissue, phosphorus can be recycled in a matter of minutes.

Phosphorus also is recycled at the bottom of lakes but at a much slower rate. There, the remains of dead plants and animals rain down more or less continuously and are decomposed. Liberated phosphorus may diffuse into the overlying water or become bound (at least temporarily) in the sediments. Its fate is very much dependent on prevailing physical and chemical conditions on the bottom. If oxygen is present, as is the case in most oligotrophic lakes and other lakes which are not stratified, phosphorus tends to combine with iron and precipitate out of solution as insoluble ferric phosphate. Absence of oxygen, a common condition at the bottom of

eutrophic lakes in summer, causes phosphorus to remain in solution. While the lake remains stratified, concentrations of phosphorus, nitrogen, and other nutrients continue to build in the hypolimnion, and mixing (spring and fall turnover of dimictic lakes) causes an upsurge of nutrient rich bottom water which then becomes available to plankton. This results in algal blooms typical of eutrophic lakes.

Nutrient control is a very important element of any lake management program. For a program to be effective, the limiting nutrient — the one in shortest supply — must be identified and controlled. Plants require 20 different elements for growth, but only two, nitrogen and phosphorus, are likely to be in short supply. The question of which nutrient is limiting has great practical importance, because control of the limiting nutrient will directly affect plant growth. Identifying the limiting nutrient is discussed further in Section 10.0 and Appendix E.

Appendix J lists a number of references containing a great deal more information on limnology than can be presented here. Wetzel (1975), Ruttner (1963), Hutchinson (1957, 1966, 1975), Cole (1980), and Valentyne (1974) are recommended for those who would like to read further on the subject.

3.3 Indices for Measuring Eutrophication

Because of the intimate interrelationship between physical, chemical, and biological conditions in lakes, a wide variety of indices of trophic condition can be measured. Indices have been based on Secchi disk transparency, hypolimnetic oxygen depletion, nutrient concentrations, and biological parameters including species abundance and diversity. Much work has been done to correlate one parameter with another. For example, chlorophyll *a* concentrations have been correlated with phytoplankton populations. Water quality scientists have narrowed down the long list of trophic indicators to a few that are related directly to eutrophication and that can be measured in quantitative terms. The major trophic indicators in use are: Secchi disk transparency, nitrogen and phosphorus concentrations, and the concentration of chlorophyll *a*. These four parameters, described in more detail in Section 10.0, measure physical, chemical, and biological manifestations of trophic state. Generally accepted ranges for them are now available for oligotrophic and eutrophic conditions (Carlson, 1979; Uttormark, 1979; and Reckhow, 1979).

Secchi disk transparency measures the clarity of water. The Secchi disk is a white disk (or white and black in quadrants), 20 centimeters in diameter, which the investigator lowers into the water on a calibrated line to the point where it disappears. It is then raised until it just reappears and the average of the two depths (usually ex-

pressed in centimeters or meters) is the Secchi disk transparency. In a lake where the suspended matter is formed primarily by in-lake processes (i.e., algal growth) and where external sources of turbidity (e.g., clay) are unimportant, Secchi disk transparency is an indirect and inverse measure of algal biomass. Values less than about 1 meter are associated with hypereutrophic conditions. Transparency values for lakes range from about 40 meters to about 10 centimeters (Hutchinson, 1957).

A large number of factors besides algal standing crop affect Secchi disk transparency. Aside from clay turbidity, the most important (non-trophic state) factor is dissolved organic color, which in high concentrations, can result in transparency values in the "eutrophic" range (< 2 m) (Carlson, 1973), even in the absence of algal turbidity. Consequently, interpretation of transparency information as a measurement of trophic conditions must be done cautiously. On the other hand, Secchi disk transparency is an attractive (and widely-used) indicator because of its simplicity and ease of measurement. It also correlates well with the public's perception of water quality.

Phosphorus is usually the most important nutrient controlling lake productivity; therefore, total phosphorus (i.e., the phosphorus present in both inorganic and organic, dissolved and suspended forms) is an important measure of trophic state. Total phosphorus concentrations in lakes (expressed in terms of elemental phosphorus) range from micrograms per liter ($\mu\text{g/l} = 1$ part per billion) in ultraoligotrophic lakes to several milligrams per liter (parts per million) in some hypereutrophic lakes. The dividing line between oligotrophic and mesotrophic lakes is usually regarded as about $10 \mu\text{g/l}$ and between mesotrophic and eutrophic lakes as about $20 \mu\text{g/l}$. In some cases a high phosphorus concentration may not produce a corresponding high level of productivity, such as where inorganic turbidity causes light limitation or where nitrogen is limiting.

Nitrogen is an important plant nutrient, but limnologists have done little to develop quantitative trophic criteria for nitrogen concentrations. In part, this situation reflects the general attitude that phosphorus is the most common nutrient factor controlling trophic state, but it also attests to the considerably more complicated chemistry and biology associated with nitrogen, and the greater difficulty involved in controlling its sources. However, in recent years, investigators have recognized that a significant fraction (albeit a minority) of lakes are nitrogen limited, and therefore criteria for nitrogen as a trophic indicator may be developed in the next several years.

Chlorophyll *a*, the principal photosynthetic pigment in plants, has been found to be a useful

indicator of algal biomass. There are several problems in relating chlorophyll *a* concentrations to the biomass of algae, but this parameter is more convenient and more easily quantified than other measures such as counting the number of individuals in a unit area. Average (summertime) chlorophyll *a* concentrations of 5 to $10 \mu\text{g/l}$ are considered the dividing range between oligotrophic and eutrophic lakes (Carlson, 1973).

In the National Eutrophication Survey of lakes in the coterminous 48 States, 574 lakes were classified as to trophic state. Only 5.4 percent were classified as oligotrophic, 17.8 percent as mesotrophic, while the remaining 77.8 percent were classified as eutrophic (Bachmann, 1980). While this was not a random survey, the proportions are probably representative of the water bodies used by the public. This indicates that many lakes have water quality problems; however, it should be pointed out that not all eutrophic lakes are impaired. From a fisheries standpoint, eutrophic lakes have higher rates of production than oligotrophic lakes though the species composition is different. Indeed, fertilizers have been used as a fisheries management tool to increase fish production in some intensively harvested waters. There is, of course, a limit, such as lakes choked with higher aquatic vegetation or with oxygen depletions that cause massive fish kills. The degree of eutrophication needs to be considered in evaluating a lake.

3.4 Management of Lakes

Some general principles for lake management and for restoring water quality in degraded lakes can be derived from the fundamentals of limnology discussed in preceding sections. First, as Hutchinson (1960) pointed out, the productivity of a lake is set by the simultaneous operation of a number of factors, only one of which is nutrient supply. Other important factors include morphometry, climate, and hydrology. Second, nutrient supplies are derived from sources external to the lake (the surrounding watershed) and also from internal sources (the lake sediments); consequently, any long-term management program must deal with both sources. Also, to be effective, programs must be designed to overcome the causes of eutrophication rather than dealing simply with the symptoms.

Where possible, the best way of reducing nutrient inputs to lakes is through diversion. The restoration of Lake Washington by diverting sewage effluents away from the lake is a classic example of a successful project. The next choice for reducing nutrient loading is through watershed management. Management involves many aspects, including: (1) controlling land-use practices; (2) developing programs to minimize loss of soil and fertilizer from agricultural lands; (3) treating streams to remove nutrients (e.g., by passing them through wetlands); (4) installing

sewage treatment systems to remove nutrients from waste water; and (5) developing laws and ordinances (e.g., to limit use of phosphate detergents, or to prohibit septic tanks in areas where soils have poor retention capacity for phosphorus). Details are discussed in Section 4.0.

For lakes with a significant, internal source of nutrients, the management program should include in-lake treatment to supplement water-

shed controls. Because of the costs involved, in-lake treatment usually is feasible only in small lakes. Removal of nutrient-rich or otherwise polluted sediments by dredging is a common restoration procedure. Chemical treatment of lake water with alum to precipitate phosphate and form a barrier for its release from the sediment has been attempted with varying degrees of success in several lakes.

4.0 WATERSHED MANAGEMENT

4.1 Overview

Water quality or aesthetic problems which occur in lakes can be associated with one or more specific contaminants present in the lake waters at concentrations which are high enough to cause objectionable conditions. Contaminants enter the lake either directly through precipitation and atmospheric dry fall, or in solution or suspension through surface or groundwater inflows. In some cases, contaminants which have entered the lake earlier, and accumulated in sediments, may be recycled to overlying waters.

If restoration is to be effective, the watershed management program must address the following issues:

- A. What is the specific problem to be corrected?
- B. Which contaminants are the principal contributors to that problem?
- C. What are the total mass loads of the selected contaminant which enter the lake within a time frame characteristic of the problem?
- D. What are the sources of these loads, and the relative amounts contributed by each source?
- E. What is the cause-effect relationship between load magnitude and problem intensity?
- F. What degree of load reduction will provide an acceptable lake response, i.e., how much contaminant input can be tolerated without causing objectionable lake responses?
- G. Which load sources are controllable in principle; which must be classified uncontrollable?
- H. For the controllable sources:
 1. What management practices/control measures are available?
 2. Which are practical in the basin be-

ing studied, given site, institutional or other constraints?

3. What are the performance characteristics and costs for controlling the contaminant?
4. What is the comprehensive management program which will provide the degree of reduction in load desired, and at what overall cost?

Water quality problems which can impair or deny desired beneficial uses of a lake can include any of the following: excessive coliform bacteria levels which restrict contact recreational use; floating debris and oil slicks which reduce aesthetic quality; biodegradable organic matter (BOD) which depletes dissolved oxygen resources; dissolved solids and heavy metals, and similar compounds which degrade the potable water supply; nutrients which accelerate the process of eutrophication; and silt which decreases water depth. To efficiently address and resolve lake water quality problems, it is important that the analyst have a clear idea which specific problem(s) and contaminants must be addressed. This obviously impacts any data collection program to be designed, but will also determine the method of problem analysis and the management practices considered.

The Clean Lakes Program focuses on lakes with recreational value, and excludes those used only for water supply (Section 6.0). Further, it is principally geared to eutrophication problems, although not to the exclusion of other problems which impair the recreational value. This emphasis is justified by the fundamental differences of such adverse recreational use effects as excessive biostimulation, high coliform bacteria counts, and unsightly floating debris. All are significant in terms of recreational use. However, problems caused by coliforms, floatables and oxygen depletion are not cumulative. Their impacts are relatively short term (days to weeks) as

shown by Figure 4-1 (Driscoll and Mancini, 1979), so that the lake does not "remember" pollutant loads of this type which entered the previous year or season, or even during the previous storm. Eutrophication, in contrast, is cumulative; each year that excessive nutrient levels, sediment loads [including particulate forms of organics (BOD) and nutrients], plankton and macrophyte growth are permitted to occur, the difficulty of arresting the rate of enrichment increases, and moves the lake closer to the point at which the process may become practically irreversible.

In this chapter, the discussion of watershed management has been structured around the assumption that the problem identified for a lake (Item A) is one of excessive biostimulation of plankton and/or rooted aquatic plants. The contaminants (Item B) have been identified as nitrogen and phosphorus; phosphorus has been determined to be of principal concern because (1) it is expected to be the nutrient in shortest supply, and (2) it is most amenable to control (Reckhow et al., 1980). The general discussion, the procedural guidance presented, and the supporting references can, with appropriate modifications, be applied to other contaminants as well. The user is cautioned, however, that detailed adjustments of monitoring or analysis programs will often be desirable where the basic problem has temporal and spatial scales for resolution that differ significantly from nutrient/eutrophication problems.

This section addresses Items C and D in subsection 4.3. Procedures for addressing Items E and F are discussed in Sections 3.0 and 8.0. With the information developed from these activities, watershed management approaches can be examined (Items G and H) using the guidance

presented in subsections 4.4 and 4.5 of this section.

4.2 Pollutant Load Estimation

The importance of accurately estimating the pollutant loads entering the lake cannot be over-emphasized. It is neither a simple nor a particularly straightforward task, but correct management decisions, and quite possibly the ultimate success of the restoration, will be influenced by this effort. Of equal importance with a reliable estimate of the total load is a reasonably accurate determination of its distribution among various contributing sources. This is important for the following reasons:

- Some sources are more controllable than others.
- Different management practices/control measures apply for different sources.
- Control efforts should be preferentially directed at the sources which are most significant.

The choice of terminology, "estimate of loads" and "reasonably accurate," is deliberate. Nonpoint source (NPS) loads cannot be measured directly because (1) they are generated over a broad area, and typically enter the lake at many locations, and (2) the principal driving force transporting nonpoint source pollutants to the lake is precipitation, which is extremely variable. Even in situations where the major input to a lake is from one or a few tributaries, the variability of rainfall and stream flow is such that even an elaborate monitoring effort for a year or more provides no *a priori* assurance that test results will translate directly to specific loads. For example, the nutrient load of interest in a lake analysis is usually a long term annual average load. Monitoring results from any particular year (a drought period, for example) may not be a good representation of the long term average.

With few exceptions, defining pollutant loads for a lake analysis and projections, and for the watershed management evaluation, will require a suitable methodology (calculation technique) to convert specific land use, water quality, hydrologic and precipitation measurements to pollutant loads on a time scale selected for analysis of lake responses. There is fairly extensive literature on and experience with such methodologies and the loading functions to be used with them. Appendix C includes an overview of such methodologies and references for the user to secure detailed information on them.

Either of two basic techniques can be used by load estimation methodologies applicable for a Clean Lakes study effort.

4.2.1 Unit Areal Loading Method

Unit areal loads are representative values of the amount of a specific chemical constituent exported from a land area of a certain size over

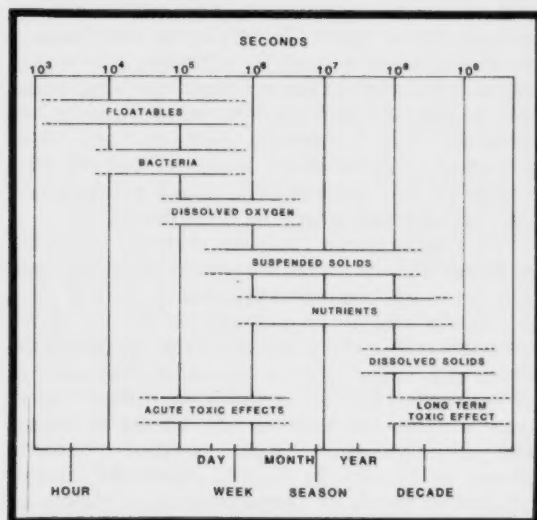


Figure 4-1. Time Scales of Water Quality Impacts.

Source: Driscoll and Mancini, 1979.

some period of time. Such values are variously referred to in the literature as area loads, areal loading rates, unit loads, and export coefficients. Dimensional terms also vary widely (lb/acre/day, tons/sq.mile/year, grams/sq.meter/year, kilograms/hectare/year), but are readily convertible by application of the appropriate dimensional conversion factors. The term "export coefficient" has been adopted in this discussion to express unit areal rates, because it has found general acceptance in lake analysis and because it emphasizes the fact that the values expressed represent what leaves the land surface. This may be different than the load to the lake where distances between source and lake are great and attenuation during transport may occur.

With this technique, representative export coefficients for the pollutant(s) of concern are assigned to each land activity within the watershed, together with the size of the area of each land use. The product of area and export coefficient provides the total contribution from each source, and the total loading to the lake is the sum of the contributions from all areas.

Table 4-1 summarizes one set of export coefficients which have been reported (U.S. EPA, 1976a). The pool of data on such values continues to grow; as this data base increases, estimates improve in accuracy and refinement as additional land use detail and geographic differences are reflected. A considerably refined set of estimating values based on the work of Reckhow et al. (1980) is presented in Appendix C. Table 4-1 indicates the significant differences between the major sources and the wide range in reported values for any single category or source. Much of the reported variation will be due to differences between individual areas (type of crop, land slope, type of soil, etc.); much will be due to climatological differences, either of a general nature (regional differences), or as a result of the particular conditions which prevailed at the time test data were developed.

Another influence on the range of export coefficients, inherent in a data base compiled from numerous literature reports, is the monitoring procedures under which the data were obtained. Table 4-2 illustrates the significant differences

Table 4-1
Approximate Relationship Between Unit Aerial Loadings from Nonpoint Sources

	Average (Kg/ha/yr)			Range (Kg/ha/yr)		
	TN	TP	TSS	TN	TP	TSS
Forest ^a	2.5	0.2	250	1 - 10	0.005 - 1	40 - 400
Range/Pasture ^a	5	0.3	400	2 - 10	0.2 - 0.6	10 - 1,000
Cropland ^a	10	0.6	1,600	1 - 40	0.03 - 0.7	300 - 4,000
Urban ^a	5	0.8	2,000	2 - 20	0.25 - 5	200 - 5,000
Feedlots ^a	1,000	250	—	700 - 1,500	100 - 400	—
Precipitation ^{b,c}	10	0.25	—	1 - 100	0.05 - 1	—
Lake Sediments ^b						
Aerobic Conditions	—	20	—	—	5 - 40	—
Anaerobic Conditions	—	150	—	—	100 - 200	—

^a Applied to watershed area.

^b Applied to lake surface area.

^c For 102 cm (40") per year.

Note: For grams/m²/year, divide by 10.

Source: Adapted from U.S. EPA (1976a).

Table 4-2
Comparison of Study Results Agricultural Nutrient Yields

Scale of Study	Nutrient Form	Nitrogen Kg/ha/yr			Phosphorus Kg/ha/yr		
		Number of Studies	Mean	Range	Number of Studies	Mean	Range
Seepage Studies	Total	15	30	0.3 - 110	9	1	0.05 - 7.5
—Lysimeter	Inorganic	28	20	0.3 - 80	6	0.5	0.01 - 2.5
—Tile Drainage							
Runoff Studies	Total	25	30	1 - 250	16	6	0.1 - 30
—Surface Runoff from Small Test Plots	Inorganic	14	1	0.01 - 5	—	—	—
Drainage Area Studies	Total	23	10	1 - 40	35	0.5	0.03 - 2.5
—Stream Sampling	Inorganic	17	7.5	1 - 20	9	0.15	0.03 - 0.6

Comparison of Mean Yields

	Nitrogen		Phosphorus	
	Total	Inorganic	Total	Inorganic
Seepage Studies	30	20	1	0.5
Small Test Plots	30	1	6	—
Drainage Areas	10	7.5	0.5	0.15

Source: Adapted from citation in U.S. EPA (1976a).

that can result in data derived from small test plots compared with larger study areas.

The unit areal loading technique for estimating pollutant loads is simple to apply and quite suitable for initial screening. It can provide early estimates of the order of the nutrient load to a lake to support initial analysis of lake impacts, and it can (together with a delineation of watershed land uses) help the analyst identify the relative importance of different watershed sources, and thereby provide focus for subsequent efforts.

Because it will usually be quite difficult to effectively reflect specific local characteristics of the study site, or important precipitation or stream flow conditions, alternative load estimating techniques should be used to supplement the preliminary analysis.

4.2.2 Flow/Concentration Techniques

These techniques (examples of which are identified, discussed briefly, and referenced in Appendix C) essentially define the characteristic concentration of the specific pollutant in the runoff from each source. Flows which emanate from specific watershed sources are defined, and the pollutant load contributed by that source is calculated from the product of flow and concentration. Where correlations between flow and concentration exist, they are employed.

There are a number of advantages to a Clean Lakes study in this approach. They include:

1. Available historical data, which can significantly enhance study efforts, will exist as flow and concentration measurements.
2. Monitoring programs conducted as part of the study will measure flow and concentration (see Section 10.0).
3. Normal temporal differences which are important in an analysis can be addressed readily. These include annual, seasonal, or short term differences in precipitation, stream flow, and land use activities (e.g., farming). This approach imposes no constraints on the time scale selected for the analysis so that it responds best to the time scale of the problem. It is adaptable to evaluating annual or seasonal nutrient loads, or storm event coliform loads.
4. Localized differences and spatial effects can be accommodated more readily. For example, leachate from a landfill or septic tanks will vary in significance depending on distance from the lake, and the amount of rainfall for the period being evaluated.

Pollutant loads will vary on an annual basis (wet vs. dry years), on a seasonal basis (normal precipitation and stream flow variation), and on a daily basis (storm events). A procedure which is adapted to any of these temporal scales provides a desirable degree of flexibility for a Clean

Lakes study. Detailed guidance on suitable methodologies of this type is available in a number of publications (U.S. EPA, 1976a; U.S. EPA, 1977) developed for EPA to support the 208 program activities. They are discussed further in Appendix C.

4.3 Sources of Pollutant Loads

A pollutant may be introduced to a lake directly, for example, by atmospheric dry-fall or by spills or dumping. Most, however, are carried in by the water entering the lake: direct precipitation on the lake surface, ground water seepage, or surface water inflows.

Surface water enters a lake through the major tributary streams which feed the lake and also by overland flow or through smaller drainage channels. These waters carry contaminants which have eroded or leached from the watershed. Even under natural conditions, i.e., without human cultural activities, these waters would carry contaminants. Cultural activities, however, tend to increase the quantity of contaminants transported into the lake and also add different types that might not otherwise occur. Just as different land characteristics of the drainage area, e.g., forest vs pasture, influence the mobility of the contaminants, and therefore the amount contributed from the watershed, different types of cultural activities in these watersheds also affect the type and amount of pollutants contributed.

Because some sources tend to contribute more of certain pollutants than others, and because the feasibility of controlling pollutants differs according to sources, it becomes important to determine the relative loads of problem pollutants from different sources and then identify the most important ones to control.

To estimate total loads, and to determine the relative distribution among major sources, the following initial breakdown is recommended:

1. Atmospheric Sources (direct to lake surface)
 - Dry fall
 - Precipitation
2. Point Sources
 - Municipal wastewater
 - Industrial wastes
3. Nonpoint Sources
 - Forest
 - Agriculture (cropland and range land)
 - Urban (storm runoff and combined sewer overflow)
 - Other
4. Special Localized Sources
 - Septic tanks
 - Feedlots
 - Landfills
 - Construction activities
5. Internal Lake Sources
 - Sediments

A further degree of breakdown may be appropriate where the contributing area for a particular source is large and/or the relative proportion of the load from that source is large. Examples would include further classification of an urban area into residential, commercial, industrial, institutional and parkland; or subdividing an agricultural source into row vs non-row crops, or type of crop. This additional effort should be undertaken only when it will improve the reliability of estimating pollutant load, or evaluating the feasibility of control. The greatest attention should be to sources that comprise major areas and major fractions of total or controllable loads.

Nutrient loading rates per unit area of lake surface are a common basis for estimating the severity of expected water quality impacts in a lake eutrophication analysis. Figure 4-2 illustrates the importance of the area of the watershed sources in terms of the surface area of the lake which receives the drainage. For this figure, loading rates have been converted to grams/square meter/year ($= 1/10 \times \text{Kg/ha/yr}$), since these dimensional terms are more commonly used in lake analysis. Nonpoint source loads, plotted for each of the land uses shown, are the average values listed in Table 4-1; each line represents a wider band, within which actual local loading rates are likely to fall. For lakes between about 5 and 50 meters deep, most of the methodologies for esti-

imating trophic state (e.g., Vollenweider, Dillon, Reckhow, etc.) will define "critical" loading rates to the lake surface in the approximate range of 0.05 to 0.5 gm/m²/year.

An initial estimate of the potential significance of a particular source can be obtained with Figure 4-2 from the ratio of the watershed area dedicated to that source, to the lake surface area.

Each of the major source classifications is discussed briefly below. The discussions include identification of the relevant features of each use, references for additional information on the source, and procedures (methodologies) for estimating loadings. Typical pollutant loadings from the source, and its subdivisions, where appropriate, are presented for comparison purposes. Appendix C presents detailed summaries of loading functions (export values) for various sources (i.e., land use/activity).

4.3.1 Atmospheric Sources

Pollutants which enter the lake surface directly from the atmosphere do so either as dry-fall, or dissolved or suspended in rainfall. Monitoring devices which exclude precipitation from the dry-fall collecting chamber, and cover the precipitation chamber during dry periods, measure the two components separately. Bulk precipitation measurements collect both components in-

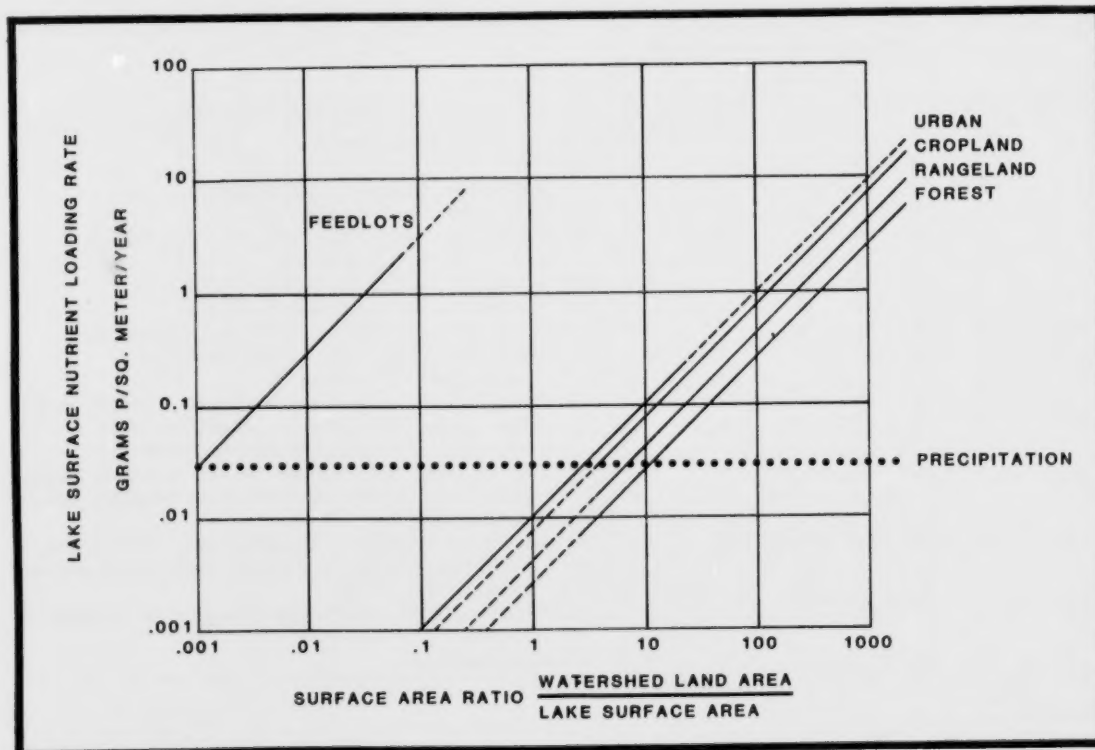


Figure 4-2. Effect of Nonpoint Source—Type and Area on Lake Surface Loading Rates.

discriminately and record the combined atmospheric contribution.

Some typical values and ranges for nutrients carried by precipitation are found in Table 4-1. Comparison of these figures with unit areal loadings shows that direct precipitation exhibits low to moderate unit loads. Where the watershed is large relative to the lake surface, direct precipitation inputs will typically be a relatively small percentage of the total load, and site specific refinements of atmospheric source estimates may be assigned low priority. For study areas where the ratio of watershed area to lake surface area is low, then improved site-specific estimates are more important.

As illustrated by Figure 4-2, nutrient loadings to a lake from direct precipitation are likely to be a significant component of total load, when watershed area is less than 10 or 20 times greater than lake surface area. However, the wide range in possible loading rates — including direct precipitation loads — will influence the actual point where this ratio becomes significant in a local area.

Atmospheric dry-fall is subject to significantly greater regional and climatological influence and can contribute a major portion of atmos-

pheric loads. For example, a phosphorous loading budget for Lake George, N.Y. (Auterbach, 1979), showed estimates of dry-fall to be about three times greater than estimates for direct precipitation.

A source of data on atmospheric pollutant loads, available to supplement any State or local program operating in a Clean Lakes study area, is the National Atmospheric Deposition Program (NADP), also known as the Acid Rain Program. An extensive monitoring station network has been established, and has been collecting data since 1979. In cases where a project determines the need to supplement information available through the NADP, manuals (NADP, 1980) prepared by this program can be helpful. In addition, the U.S. Geological Survey and EPA's National Urban Runoff Program (NURP) are monitoring wet and dry-fall at a number of sites around the country, and should be considered a potential source of information on determining local atmospheric source loads.

Atmospheric source loads must be defined for each study to accurately establish total loads to the lake. The reliability of this estimate, and hence the appropriate level of effort, will be

Table 4-3
Typical Treatment System Performance—Municipal Wastewaters

Effluent Characteristics (mg/l)								Description of System
Number	BOD ₅	TSS	COD	Total P	NH ₃ -N	NO ₃ -N	UOD ^a	
—	210	230	400	11	20	0	406	Raw Waste Characteristics
1	130	100	250	9	20	0	286	Primary
2	100	50	185	2	20	0	241	Primary and Metal Salt Addition (FeCl ₃)
3	45	60	90	8	18	0	150	Primary and Trickling Filter
4	25	30	50	2	18	0	120	Primary and Trickling Filter with Metal Salt (FeCl ₃)
5	20	20	45	7	17	0	107	Primary and Activated Sludge
6	15	15	35	2	17	0	100	Primary, Activated Sludge, Metal Salt (Alum)
7	10	20	35	8	2	18	24	Primary, Activated Sludge/Nitrification
8	10	20	45	8	1	1	20	Primary, Activated Sludge, Nitrification, Denitrification
9	10	10	45	1	2	18	24	Primary Metal Salt Addition (Alum), Activated Sludge/Nitrification Filtration
10	5	5	25	1	20	0	99	Preliminary, Two-Stage Lime, Filtration, Carbon Adsorption
11	5	5	30	0.5	1	1	12	Primary Metal Salt Addition (Alum), Activated Sludge, Nitrification, Denitrification, Polymer, Filtration
12	3	5	10	0.5	1	1	12	Primary Metal Salt Addition (Alum), Activated Sludge, Nitrification, Denitrification, Polymer, Filtration, Carbon Adsorption
13	20	20	45	—	17 ^b 2 ^c	0	107	Small-Flow Treatment Systems, i.e., Package Plants —Extended Aeration Plant 0.01-0.1 mgd; contact stabilization plant 0.1-1.0 mgd
14	15	15	46	6	1	8	27	Oxidation Ditch; 0.05-10 mgd (designed for nitrogen removal)
15	—	—	—	—	—	—	—	Land Application

^a UOD = Ultimate Oxygen Demand = $(1.5 \times \text{BOD}_5) + (4.57 \times \text{NH}_3\text{-N})$.

^b Contact Stabilization.

^c Extended Aeration.

BOD = Biochemical Oxygen Demand.

TSS = Total Suspended Solids.

COD = Chemical Oxygen Demand.

Note: Treatment systems 1 to 12 include disinfection, sludge handling, miscellaneous structures, and support personnel.

Source: U.S. EPA (1976a).

strongly influenced by the size of the watershed relative to the lake surface area.

Although 208 and Clean Air programs may reduce local contributions, atmospheric loads probably should be considered to be "uncontrollable" within the context of a Clean Lakes study, on the basis that the spatial scale and time frame of such programs must encompass a large portion of the country and probably require decades to implement.

4.3.2 Point Sources

All point source discharges of municipal or industrial wastewaters are covered by EPA's National Pollutant Discharge Elimination System (NPDES), and are regulated by permit. Permit conditions specify maximum allowable flows and mass loadings (and/or concentrations) for a list of specific pollutants. Pollutants on the permit list vary somewhat according to the particular source, and include those which are significant components of that source.

Point source pollutant loadings can be determined from actual data. Self-monitoring and routine reporting of wastewater discharge flow and quality are basic requirements of the NPDES permit, and results should be readily obtainable from EPA Regional Offices.

For perspective and illustrative purposes, Tables 4-3 and 4-4 present some quality characteristics typical of municipal wastewater discharges and some classes of industrial wastes. As shown, effluent quality for some contaminants will vary with the degree of treatment applied. These tables provide an initial sense of the potential significance of a particular point source, given the size and nature of the operation, so that subsequent efforts may be prioritized and directed.

The analyst should be aware that specific contaminants may not be regulated for a particular point source discharge, and hence may not be covered by the NPDES monitoring and reporting requirements. For example, paper mills are typically deficient in nutrients — to the extent that nitrogen and phosphorus are usually added for effective operation of biological waste treatment systems. Thus effluents will usually contain residual concentrations of nitrogen and phosphorus, and could provide appreciable mass loadings to the lake. For this reason, point source loadings for any parameters not routinely reported should be established.

Point sources are to be one of the more readily controllable pollutant loading sources. They represent a concentrated, accessible source legally bound to greater degrees of treatment where it

Table 4-4
Typical Industrial Effluent Concentrations

Parameter	Approximate Mean Effluent Characteristics (mg/l) ^a					
	Food	Textiles	Paper	Chemicals	Petroleum	Metal
BPT-1977						
TSS	40 ^b	49 ^b	58 ^b	40 ^b	10 ^b	20 ^b
BOD ₅	29 ^b	22 ^b	39 ^b	30 ^b	15 ^b	38 ^b
COD	135	225 ^b	156	1,400 ^b	102 ^b	—
TDS	—	700	3,785	4,350	—	—
Cl	565	25	135	—	—	—
Total-P	17	2	—	5	—	.50
Total-N	50	2	—	20	70	62 ^b
Lead	—	.03	—	2 ^b	—	.25 ^b
Zinc	—	5	—	0.25 ^b	—	.25 ^b
Cadmium	—	.005	—	.225 ^b	—	.15 ^b
Oil	10 ^b	10	—	15 ^b	5 ^b	5 ^b
BAT-1983						
TSS	10 ^b	8 ^b	23 ^b	13 ^b	5 ^b	5 ^b
BOD ₅	7 ^b	11 ^b	22 ^b	15 ^b	5 ^b	4 ^b
COD	48	72 ^b	88	460 ^b	26 ^b	—
TDS	—	700	3,785	4,350	—	—
Cl	565	25	135	—	—	—
Total-P	1.2	2	—	3	—	0
Total-N	9 ^b	2	—	3	28	5 ^b
Lead	—	.03	—	1 ^b	—	0 ^b
Zinc	—	5	—	.25 ^b	—	0 ^b
Cadmium	—	.005	—	.05 ^b	—	0 ^b
Oil	10 ^b	10	—	3	1.35 ^b	5 ^b

^a Represents an approximate estimate of the mean effluent concentrations for each industry. The pollutant concentration could vary widely within an industry as a result of varying water usages.

^b Concentrations developed from effluent guidelines which exist for these parameters; other concentrations were obtained from any existing treatment plant data found in the Development Document.

can be demonstrated that it is (a) necessary to protect water quality and (b) cost-effective compared with treatment of nonpoint sources.

4.3.3 Nonpoint Sources

As stated earlier, estimation of site-specific nonpoint source loads is not straightforward, nor is the determination of either the extent to which they can be controlled or the most effective watershed management plan. Determination of nonpoint source loads, which may involve designing effective monitoring programs, evaluating data for estimating loads on the desired time scale, and developing an effective management plan for their control, will frequently prove to be among the more challenging tasks for a Clean Lakes study.

An effective monitoring program which characterizes important local features of the study area will be critical, and given the diffuse nature of nonpoint sources and normal time and budget constraints, considerable attention will be required, not only to optimize this effort, but even to make it effective. In addition, it is unlikely that monitoring data (and historical data) will directly reflect the pollutant loads required in the analysis. In most cases, such data will provide the necessary site-specific information required to develop load estimates on the time and space scale required for analysis of lake impacts, and for the evaluation of control alternatives.

Detailed guidance on estimating procedures and designing monitoring programs is provided by a number of reports and EPA manuals (U.S. EPA, 1976a; U.S. EPA, 1977; Reckhow, 1979). A careful review of these and other pertinent publications is recommended.

Some 225 planning studies under the 208 program have been performed, placing significant emphasis on nonpoint sources. These studies, many of which are continuing, may provide useful references for Clean Lakes studies. For specific information on selected sources, Federal or State agencies may provide information, guidance, reference material or direct assistance. Examples include:

- 1. U.S. EPA (Headquarters and Regional Offices)
2. State Environmental Protection Agencies
3. Department of Agriculture (Soil Conservation Service)
4. U.S. Forestry Service/State Forestry Groups
5. Urban Planning Agencies (Local and Regional)
6. Bureau of Mines
7. Corps of Engineers
8. U.S. Geological Survey
9. NOAA (climate and precipitation records)

Specific guidance for contact with some of these groups is provided in a U.S. EPA publication (1976a), and with EPA Regions for guidance on others.

Brief discussions are presented here on each of the major categories of nonpoint sources. The intent, within the scope of this manual, is to highlight the salient features of each source, identify some of the important general considerations, and refer the reader to available documents that provide greater detail and more in-depth discussion.

4.3.3.1 Forests. Forested watersheds in an undisturbed condition (not necessarily virgin forests) are generally lowest of all nonpoint source categories in export of pollutants. Further control of undisturbed forests is not usually considered; runoff flows and pollutant concentrations are low enough that further reduction would very likely be technically unrealistic and/or costly.

Pollutant loads from forested areas will vary with climate, type and age of trees, type of soil, and topography of the area. Nutrient export coefficients covering a variety of such conditions are given in Appendix C.

The harvesting of trees and subsequent reforestation, can increase the potential for pollutant export. Some typical activities include:

1. Construction, use and maintenance of access roads and skid trails
2. Timber harvesting
3. Reforestation, including associated site clearing
4. Burning
5. Chemical application of fertilizers and pesticides
6. Nonsilvicultural activities such as camping, recreational travel, fishing, hunting and livestock grazing.

Because of the very high degree of site-specificity, there are no typical values for export of various pollutants which can be presented for various silvicultural activities. Normally, only a very small percentage of the total forested watershed is subjected to a particular activity at any one time, and such activities are not a permanent feature of the area. Recovery of an area is relatively short in relation to the overall cycle, so that within 2 to 6 years most areas have returned to the equivalent of an undisturbed condition. In addition, during a recovery period, some partial degree of protection is provided. Because of these factors, and because actual contribution of pollutants will be strongly influenced by the location of the activity in relation to topography, soil characteristics, and proximity to streams, pollutant contributions from silvicultural activities must be evaluated on a site specific basis.

General procedural approaches are presented in several EPA documents (U.S. EPA, 1976a; U.S. EPA, 1977). A detailed procedure for evaluating nonpoint source loads from silvicultural activities has been developed in a handbook by the

U.S. Forest Service (Currier et al., 1974). The salient features of this procedure are described in Chapter 19 of the proceedings of a recent waste management conference (Loehr, et al. 1979).

To illustrate the relative potential for the various silvicultural practices to export pollutants, Table 4-5 summarizes estimated average erosion rates in different "Land Resource Areas" within the State of Louisiana, showing the estimated percentage of each area on which specific practices take place. The different Land Resource Areas are characterized by differences in rainfall, topography, and soil type. Erosion rates were calculated, in this case by a modification of the Universal Soil Loss Equation (USLE), except that field evidence was used for estimates for skid trails and access roads, for which the equation does not work well.

The other major potential source of pollutants from silviculture is from applications of fertilizers and pesticides. Fertilizers applied to forest lands can enter water bodies by direct application or by leaching through the soil. The potential for direct introduction to surface waters is normally restricted to aerial applications. Almost all the fertilizer applied to a given site reaches the forest floor with no appreciable loss due to volatilization or interception by the forest canopy. Once on the forest floor, there is normally no loss by overland flow. Studies have shown that forest soils have the capacity to tie up many times the amount of fertilizer normally applied, which virtually eliminates any significant water body contamination by leaching.

Pesticides used in forest management include

insecticides and herbicides. Their potential impact on water quality depends on their mobility and persistence, and on the accuracy of placement and orientation to streams. Insecticide use on forest lands has been tightly regulated in recent years. Most insecticides in use are relatively immobile and short-lived. Chlorinated hydrocarbons are more of a problem because of toxicity, persistence, and biomagnification, but are rarely used, and subject to EPA approval. Herbicide compounds in use are generally not very toxic and do not biomagnify. Herbicides are usually more mobile than insecticides; even so, movement is usually measured in terms of only inches or a few feet. Characteristics are specific to the compounds in use, so that the compounds actually applied should be identified in order to properly evaluate impacts.

The most significant potential vehicle for transport of either applied chemicals or naturally occurring compounds into receiving waters, thus appears to be through erosive action. Load estimating techniques for forested areas and the impact of silvicultural activities are most appropriately those which address and evaluate site-specific differences in erosion.

4.3.3.2 Agriculture (Cropland and Range Land).

Cropland is one of the most significant potential sources of nutrient and silt to lakes. Unit loading rates tend to be high, and relatively large portions of the watershed will often be devoted to agricultural activities. A wide variation in nutrient export is possible. In addition to the common factors of soil type, slope, proximity of water

Table 4-5
Estimated Average Erosion Rates^a

Forest Condition	Recovery Period (Years)	Tons/Acre/Year ^c				% of Area in Indicated Use			
		Land Resource Area				Land Resource Area			
		A	B	C	D	A	B	C	D
Natural	—	.0004	.015	.004	.004	—	—	—	—
Logging	3	.045	.101	.106	.016	5.2	6.3	6.4	4.5
(Timber Harvest)									
Skid Trails	4	14.0	36.2	30.3	1.0	0.2	0.3	0.3	0.2
Access Roads	4	23.0	86.8	52.9	2.6	0.06	0.06	0.07	0.06
Chop, or Chop and Burn	3	.07	.32	.176	.066	1.4	1.4	1.0	1.4
Shear and Windrow	4	.40	2.73	2.40	.386	1.9	0.4	1.0	0.4
Burn	3	.05	.075	.036	.026	0.4	7.7	8.0	11.6
Grazing	—	.048	.045	.016	.016	9.1	28.0	14.0	53.0

^a Louisiana Forested Areas.

^b Average for Southern States.

^c Suspended Solids. To convert to kg/ha/yr, multiply by 2238.

Source: (Alan H. Plummer Associates, 1979)

courses, and climate, the type of crop, cultivation technique, and length of growing cycle strongly influence the erosive potential and hence the tendency for export of pollutants. The use of fertilizers and pesticides is common, and the care and timing of applications have an important effect on export of these chemicals.

A useful and well developed methodology exists for evaluating the relative tendency of cropland to export pollutants under various sets of site-specific conditions. This methodology is the Universal Soil Loss Equation (USLE) developed and applied for many years by the Soil Conservation Service (SCS) of the U.S. Department of Agriculture. The equation is:

$$A = RKLSCP$$

where: A = Average annual soil loss in tons/acre

R = Rainfall and runoff erosivity index

K = Soil erodability factor

LS = Dimensionless topographic factor representing the combined effects of slope length and steepness

C = The cover and management factor

P = Factor for supporting practices

An extensive data base exists to support the estimation of numerical values for each of the factors in this equation, either on a regional basis, or on a site-specific basis when appropriate local data are available.

The application of this equation appears in many publications, and it is incorporated in a number of watershed load-generating mathematical models. Perhaps the most appropriate initial references for a Clean Lakes Program analyst to examine are the *Areawide Assessment Procedures Manual* (U.S. EPA, 1976a) and *Water Quality Assessment: A Screening Method for Non-Designated 208 Areas* (U.S. EPA, 1977). These references discuss the application of this equation to estimation of pollutant export, describe a methodology for applying it, and present summary tables and graphs to assist in the estimation of the various factors in the equation. Annotated bibliographies for further reference are also included.

A comprehensive source of information relating to evaluation of loads and approaches to control will be found in the joint EPA/USDA document, *Control of Water Pollution From Cropland* (1975).

The user should be cautioned, however, that the basis for the technique, as developed by SCS, was for evaluation of the effect of various agricultural practices and site characteristics on the erosion of topsoil. In its basic form, it addresses the potential for precipitation to dislodge and transport (erode) soil particles, and makes no statement concerning export from the

immediate area through entry into water courses and transport by stream flow to more distant water bodies.

In the adaptations which address water quality effects, various empirically derived factors are applied:

1. Sediment delivery ratio—estimates the percentage of the soil dislodged which will enter the stream. Figure 4-3 relates this factor to soil type and the relative proximity of streams.

2. Enrichment ratio—estimates the nutrients and other chemicals exported to water bodies as a function of the sediment transport.

These ratios are relatively crude approximations, and are difficult to estimate reliably for site-specific conditions. For this reason, and also because loads can be modified significantly during transport by a stream to a lake some distance away, this methodology will be less reliable as an estimator of loads to a lake than would monitoring of flow and quality of lake inflows. Without site-specific calibration, it probably offers no improvement in reliability of lake loadings over the use of unit areal loading rates (export values per list in Appendix C).

The USLE does, however, have considerable value in a watershed management study for a Clean Lakes Project. With local estimates for the factors in the equation, it provides a sound basis for estimating the relative contributions to be expected from various segments of the watershed. Where an independently derived estimate of total loads has been obtained, estimates of loads from individual segments can be determined. In addition, the relative effect of different practices, and the expected relative distribution of loads during different times of the year can be estimated. Where the relationship to total load has been established, changes in total load can be estimated.

Figure 4-4 projects variation in erosion potential (and hence nutrient or pollutant export) derived from the USLE. Monthly variations in rainfall characteristics, and changes in ground cover over the crop cycle can be defined and an estimate made. One obvious value of such an exercise is the insight it can provide for designing of an effective monitoring program. The accuracy of an estimate of annual loads to a lake will be greatly enhanced where monitoring efforts concentrate on the period where the major portion of the exported load is expected.

Fertilizers are now used abundantly on commercial crops in the United States. The potential for pollution will generally be highest where large areas are treated with high application rates of fertilizers. Table 4-6 summarizes on a national basis the percentage of the total crop which is treated with chemical fertilizer and the national average application rate (U.S. EPA/USDA, 1975).

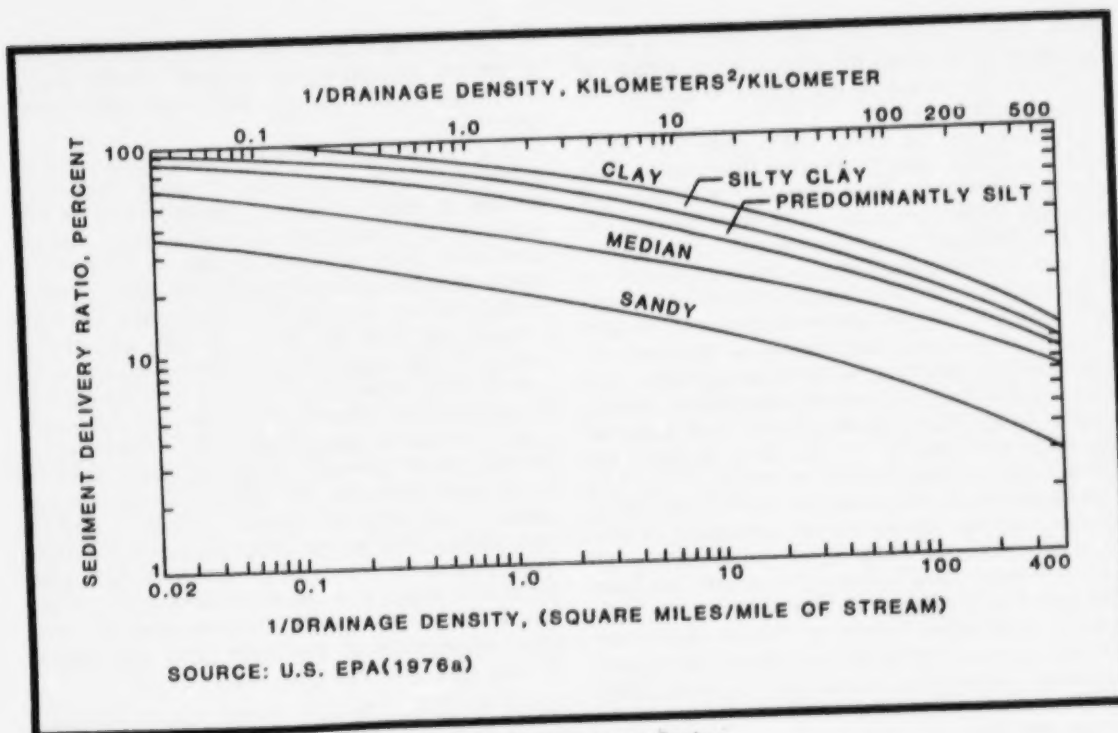


Figure 4-3. Sediment Delivery Ratio for Fairly Homogeneous Basins.

Source: U.S. EPA, (1976a).

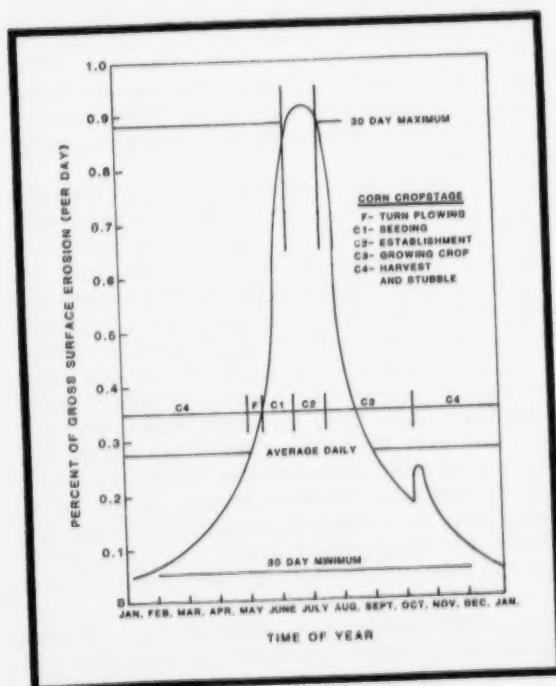


Figure 4-4. Projected Variation in Soil Erosion.

Source: U.S. EPA (1976a).

Local practice could differ significantly from these averages. Nutrients can be applied singly or in combination, and the relative amounts of N and P will vary with the formulation used.

Phosphorus moves primarily by erosion because phosphate adsorbs strongly on soil particles. Although some soluble phosphorus compounds do move in runoff water, the amount exported via this route is usually small because, even when soluble orthophosphate is used in a fertilizer application, it soon converts to insoluble forms in the soil (U.S. EPA/USDA, 1975).

Where nutrient contributions to a lake from cropland are expected to be an important component of the total input to a lake, it will be important to determine the relative amounts of land devoted to specific crops. The type of crop

Table 4-6
Acres Receiving Fertilizer and Average Fertilizer Rates of Four Crops in the United States in 1974

Crop	Hectares Harvested (million)	Percent Fertilized		Rate (kg/ha)	
		N	P	N	P
Corn	25.8	94	87	115	30
Cotton	5.3	79	58	87	26
Soybeans	21.3	22	28	17	20
Wheat	26.0	66	46	51	19

grown (and this may involve a 2 or 3 year rotating cycle) determines the extent and duration of ground cover, and also the type and quantity of applied fertilizer.

Livestock can be a significant source of nutrients to surface waters, whether they are grazing on pastureland or being raised in confinement (feedlots or buildings, such as dairy barns). Table 4-7 presents typical values of manure production and manure nutrient content for various domestic animals. The extent of nutrient transport from pastureland depends on the kinds and number of animals, their density on the pasture, proximity to receiving waters, topography, and weather conditions. Confined operations usually involve larger numbers of animals, and, because the large amounts of manure they produce are almost always disposed of on nearby land, they can cause more serious water quality problems. In the northern states, winter spreading of manure on frozen ground or snow, followed by high nutrient export during thaw and runoff, has been identified as the cause of nutrient enrichment in a number of lakes. Provision of adequate winter storage to allow spreading to be postponed until weather conditions permit expeditious incorporation into the soil has proved to be an appropriate management practice.

Farmland is a potentially significant source of lake nutrients. It is also a potentially controllable source though it may be difficult institutionally to control. The well developed methodologies

for evaluating export potential under different conditions should permit a fairly reliable analysis of this source for use in the lake restoration effort.

The use of pesticides (especially herbicides) in agricultural operations has increased sharply in the last 3 decades. Many investigations of the presence of pesticides in runoff from treated land have been reported. Nearly all lead to the same general conclusion: except when heavy rainfall occurs shortly after treatment, concentrations are very low and the total amount of pesticide that runs off the land during the crop year is less, often much less, than 5 percent of the application. Where chemicals are highly toxic and persist for long times, even these low levels may be of concern. However, many agricultural chemicals are not acutely toxic, do not persist from one crop season to the next, and do not accumulate in the food chain (EPA/USDA, 1975). More detailed information in this reference will assist site-specific evaluations of potential for concerns, and estimates of export with local knowledge of pesticide type, application timing and rate, soil type, etc.

4.3.3.3 Urban Runoff. Urban runoff pollutant loads and control approaches have been studied extensively over the past decade. A substantial data base on pollutants in urban runoff has been assembled (Huber et al., 1979), and a number of methodologies for projecting urban stormwater loads have been developed, tested and applied. The AAPM, various user support documents for EPA stormwater management models (Lager et al., 1976; Heany et al., 1976; Heany and Nix, 1977), and a statistical method for assessment of urban stormwater (Driscoll et al., 1979) describe procedures for estimating stormwater loads for urban areas.

Because of the variability of rainfall, and the apparently random factors influencing the magnitude of loads which result from individual storms, the observed data on pollutants are quite variable. Nevertheless, typical ranges can be established, and mean values for the concentration of specific pollutants will provide reasonable estimates for loads on an annual cycle when matched with the amount of rainfall which reaches a water body as runoff. Figure 4-5 summarizes data on urban stormwater concentrations of specific contaminants. While various local factors may influence typical values for an area (e.g., land use distribution), the major distinction in the pollutant levels in urban runoff is on the basis of the type of conveyance system used. Differences in concentration levels in urban runoff discharged by separate storm sewers or combined sewer overflows are shown by this figure.

Unit areal loadings of phosphorus from urban runoff are relatively high, in comparison with other nonpoint sources. Combined sewer

Table 4-7
Manure Characteristics

Animal	Size (lbs)	Total manure production (lb/day)	Nutrient Content	
			N(lb/day)	P(lb/day)
Dairy cattle	150	12	0.06	0.010
	250	20	0.10	0.020
	500	41	0.20	0.036
	1000	82	0.41	0.073
	1400	115	0.57	0.102
Beef cattle	500	30	0.17	0.056
	750	45	0.26	0.084
	1000	60	0.34	0.11
	1250	75	0.43	0.14
Swine				
Nursery pig	35	2.3	0.016	0.0052
Growing pig	65	4.2	0.029	0.0098
Finishing pig	150	9.8	0.068	0.022
	200	13	0.090	0.030
Gestate sow	275	8.9	0.062	0.021
Sow & litter	375	33	0.23	0.076
Boar	350	11	0.078	0.026
Sheep	100	4.0	0.045	0.0066
Poultry				
Layers	4	0.21	0.0029	0.0011
Broilers	2	0.14	0.0024	0.00054
Horse	1000	45	0.27	0.046

Metric equivalents: 1 lb = 0.454 Kg

Source: Neptune, 1976

areas may generate three or four times greater phosphorus loads than separately sewered areas. The significance of urban runoff as a load source for a lake will depend on the relative size of the urban area in relation to the overall watershed, and the type of stormwater conveyance system it has.

The possibility for controlling urban stormwater exists, although probably on a site-specific basis. Control of combined sewer overflows (CSO) is, at the present time, likely to be more feasible, because (a) discharges will be concentrated at a limited number of locations (the overflow locations); (b) several control devices have been tested and demonstrated, and performance characteristics established; (c) institutions exist (201 agencies) for implementing decisions for control; (d) EPA policy is to control such discharges where they adversely affect water quality and uses; and (e) controls can be funded through the 201 construction grants program.

Separate stormwater discharges are usually more difficult to control because sources are diffused over the urban watershed and controls may have to be applied in many locations. In addition, cost and performance characteristics of potential controls are not well defined, nor is there any current provision in the 201 construction grants program for funding separate stormwater controls. EPA's National Urban Runoff Program (NURP) intends to determine the cost and performance of suitable control measures, so that at least some of the con-

straints should be reduced by 1982, when this program is completed.

4.3.3.4 Other Nonpoint Sources. Other nonpoint sources or activities (such as mining, hydrologic modifications, irrigation returns, residuals management) may be important in some areas. The AAPM (U.S. EPA, 1976a) discusses these sources, and includes references and an annotated bibliography directing the user to other publications which address these load sources.

4.3.4 Special Localized Sources

A number of sources of nutrients and other pollutants have a potential for high loading rates on a unit areal basis. In many cases, because of the small fraction of total watershed area associated with these activities, they will prove to be relatively minor contributors to the total load entering a lake. Local conditions, however, can give them great significance; and, because of their potential for high load contributions, they should receive consideration. In small watersheds, or where the activity is close to the lake or to feeder streams, such sources can be quite important. They tend to be more subject to control, principally because they are restricted to limited areas.

4.3.4.1 Septic Tanks. Under normal conditions, septic tank/tile field disposal systems in good operating condition will be a negligible source of pollutants (particularly phosphorus) to surface waters. The degree of treatment provided by the system and the limited mobility of phosphorus in the soil drain field are such that septic tanks, as a source of lake loadings, can be ignored except where drain fields are close to the lake or a direct feeder stream (100 meters), or where systems are failing and significant amounts can reach water courses through overland flow.

An important element that determines whether a septic tank system (tank and drain field) will be in good operating condition is whether it is regularly and frequently maintained. In systems with leach fields, layers of essentially impervious organic matter build up under the field and prevent downward seepage. This may slowly create a perched water table (the familiar soggy, green lawn), and nutrient discharge to the lawn surface. Rain may then wash across the sloped lawn into roadside ditches, and thence to receiving waters.

Procedures for estimating septic tank contributions are described by Rodiek (1979) and Reckhow et al. (1980), and incorporate information on the number of persons per residence, the percentage of time the residence is occupied, and the soil type and condition.

A preliminary estimate may identify the relative significance of septic tank sources to the total nutrient budget, and hence the importance of

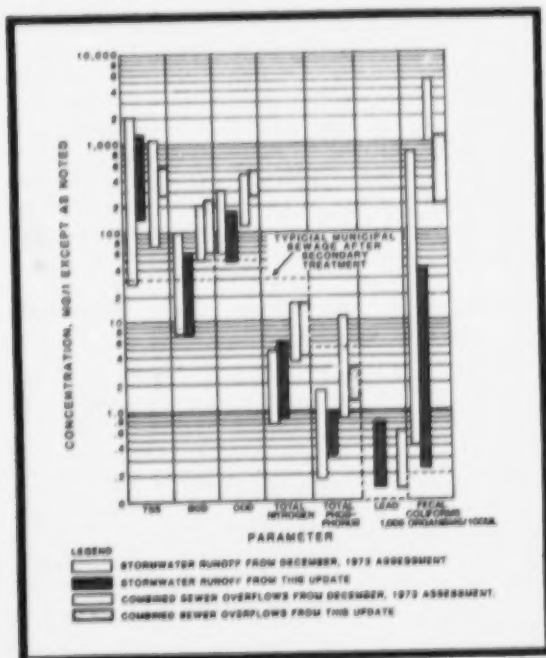


Figure 4-5. Urban Stormwater Quality.

Source: Lager et al., 1977.

more careful evaluation, by estimating an upper bound for such sources based on an annual per capita contribution of total phosphorus. Typical estimates for such loads (Rodiek, 1979) are:

1. 1.6 kg (per person per year) with phosphorus based detergents
2. 0.5 kg (per person per year) without detergents.

When appropriately factored by time in residence at the site, this provides an upper limit for phosphorus contribution, assuming there is no removal by the septic/soil system. In cases where this contribution may not be sizeable, additional information on site conditions such as age of system, size of system, and water table depth will be required to estimate removals which take place. Dye tests or the use of flow-through fluorometers may be employed to provide additional information.

4.3.4.2 Landfills. This is a potential source which may or may not be significant in a particular study. The size and age of the landfill are important, but of greatest significance is the drainage pattern, the location of the water table, the practices employed, and the imperviousness of the soil. Site-specific monitoring of leachate or a nearby water course is required to estimate loads which may be contributed by landfill operations.

4.3.4.3 Construction. Construction activities associated with housing, highways, dams, and stream channel improvements are usually in progress in some part of a watershed. The most significant aspect of construction activities for a lake study is the fact that any particular construction project is temporary. The time scale of interest in defining lake nutrient loadings is quite long in relation to the normal period of active construction. Thus, while it may be instructive to estimate load inputs from construction in progress during the study, the analyst should be principally concerned with estimating the average intensity of such activity (percent of watershed area under construction) in recent history, and anticipated in the future.

Sediment is the principal contaminant exported to water courses by construction activities, and control tends to be practical and reasonably effective. A number of activities inherent to construction, other than earth moving and exposure of ground surfaces, may contribute other contaminants. Housing and temporary sanitary facilities for workers, topsoil movement and storage, pesticide use, seeding and fertilizing, access roads, storage and use of petroleum products, and trash disposal all increase the potential for contaminants other than sediment. The significance of these will vary widely on a site-specific basis.

4.3.5 Internal Lake Sources

Although this assessment is more properly

part of the lake water quality evaluation, it is appropriate to identify it here in a discussion of nutrient sources which contribute to an annual load balance.

In addition to nutrient influx from external sources, the nutrient status of lakes depends also on the degree of internal nutrient recycling that occurs. It is well established that, on an annual basis, most lakes are nutrient traps; they receive nutrients in excess of the amount discharged through their outlets. These nutrients are stored in bottom sediments, and the large amounts typically found there attest to the trapping efficiency of lakes (Uttormark, 1979).

Seasonal changes in near-sediment conditions can cause the release of nutrients to overlying waters where they may remain for several months, to be redeposited in the sediments later. Thus, superimposed on the net annual flux of nutrients to the sediments are seasonal surges of release and deposition. Nutrient recycling is likely to be most important in eutrophic lakes, where it reinforces already high nutrient levels and provides a buffer that may resist lake restoration efforts.

Anaerobic conditions in bottom waters enhance the transfer of nutrients from sediments to overlying waters. Exchange rates for anaerobic systems are known to be several times as large as those for aerobic systems. The order of magnitude of sediment release rates which have been identified (Thomann, 1980) range from 0.5 to 5 gram/m²/year under aerobic conditions to 10 to 20 gram/m²/year for anaerobic conditions.

Another dimension of this process is the addition of nutrients to surface waters from littoral, or shallow water sediments. Although exchange rates may be smaller than for deepwater sediments, the surface waters are normally well mixed, eliminating any inhibition due to stratification, and the net effect may be very significant. In addition, under some circumstances, rooted aquatic plants serve as nutrient pumps, expediting the exchange process (Uttormark, 1979).

4.4 Control Measures for Watershed Management

The concept of watershed management by applying BMPs (Best Management Practices) is directed at reducing pollutant loads at the source, or intercepting them upstream in the drainage system. Among the potential BMPs, some "soft" structural control measures are included, such as retention basins. The BMP concept is to apply control measures at multiple locations throughout the watershed, or that portion of it which contributes the loads most significant to water quality.

An important feature of using BMPs to control nonpoint source loads is that to be effective they must be applied broadly, over a significant part

of the area of the source selected for control. For example, street sweeping must reach a large proportion of the urban streets, at a high enough frequency to achieve significant reductions; erosion control must be practiced on a large enough segment of an agricultural area to obtain desired load reductions.

Management practices tend to be quite specific to the nature of the source, that is, the land use or activity. In addition, many control measures which generally apply for a particular source may not be usable in a specific watershed, due to local conditions. The selection of cost-effective management practices will, therefore, be a strongly site-specific exercise, and one which requires a good knowledge of local conditions.

Management practices which are "best" for reducing the export of pollutants are not necessarily those which are "best" economically for the land uses affected. For example, buffer strips between cropped areas and stream courses would reduce pollutant export, but also reduce the acreage in productive use for the farmer. Such factors must be taken into account in developing of an equitable, practical watershed management plan. Local or regional agencies that understand the watershed and the interests involved should always be involved in watershed management planning. Examples include Soil Conservation Districts for agricultural sources, 208 planning agencies for urban areas, and Drainage Districts. While some control programs are being implemented by enactment of ordinances (principally in urban areas), effective programs for many of the nonpoint source categories will depend on cooperative approaches.

In general, BMPs are free. For many, operation and maintenance must be recognized and provided for. For some techniques, disposal of residuals must be considered. If these aspects are neglected, it is not reasonable to expect that removing pollutants, or preventing their generation, will continue at whatever initial levels are achieved.

Appendix C lists management practices and control measures that have been suggested, and tested in many cases, for the control of nonpoint source loads. The lists are organized by source type. Because of the great variety, simple generalizations on performance capabilities or applicability either cannot be made or would not be very instructive. The user is referred to EPA manuals or other literature sources for the detail necessary to evaluate those that will be applicable in the local watershed.

4.5 Institutional Considerations

A critical element of an effective watershed management program will be the attention given to institutional considerations. The technical aspects of a Clean Lakes study may identify the nonpoint source loads which are important to

control and define feasible methods for effecting the necessary control. However, unless these decisions can be carried out in a timely and effective manner, watershed control will never progress beyond the planning stage. Institutional structures in the watershed are of major importance for the long-term protection of lakes through watershed management.

Institutions having the required status and authority in a study area may be public or private. They must be capable of coordinating, financing, managing, and monitoring, and they must have the authority and resources to execute necessary watershed management measures. Institutions may offer positive and/or negative incentives that stimulate the installation, maintenance, and continued operation of physical control measures (Bailey and Waddell, 1979).

An effective institutional structure may or may not exist in a Clean Lakes study area. Where one does not, new organizations may be needed to solve certain watershed problems. Development of a suitable institutional structure may prove to be complex due to watershed size, geographic and political diversity, existing institutions with water quality management responsibilities in the watershed, and the absence of a single coordinating organization with oversight responsibilities. There is room for innovation in institutional as well as technical aspects of watershed management, although the establishment of new institutions may prove to be time-consuming and not politically expedient.

4.5.1 Institutional Roles and Responsibilities

Table 4-8 lists some of the activities and re-

Table 4-8
Functions of a Management Agency

General Coordination and Management of Watershed Programs
— Maintain formal and informal working relationships among institutions
— Program evaluation, including monitoring and revisions
Fiscal Management
— Incurrence of long-term indebtedness
— Acceptance and utilization of grants
— Ability to raise revenues
Develop and Conduct Public Education and Public Participation Programs
Apply Implementation Incentives, and/or Exert Regulatory Force Where Voluntary Efforts are not Effective
Perform or Contract for Necessary Technical Services
— Design, construction, operation, and maintenance of physical control measures
— Technical evaluation of water quality and effectiveness of program
Develop and Maintain a Comprehensive Watershed Data Base, Including Water Quality and Watershed Related Information, Required for Effective Continuing Planning and Management

sponsibilities of a single agency, or cooperating agencies, pertinent to managing a watershed to control nonpoint source loads.

Certain Government agencies at the Federal, State, regional, or local levels may already have water quality/watershed-related management responsibilities that apply to the watershed. These agencies may have some or all of the following capabilities that could be integrated into the watershed management program:

1. Regulating activities and requiring certain practices and techniques (e.g., sediment and erosion control programs).
2. Providing economic assistance or tax advantages to activities which institute control practices.
3. Providing technical assistance.
4. Carrying out educational programs to gain acceptance and aid in implementing controls.
5. Accepting responsibility for implementing specific runoff and other control programs.
6. Providing planning activities for water quality management, land use, population, housing, economic growth, etc.

Homeowners and other citizens' organizations often implement and enforce self-imposed restrictions and covenants, providing high levels of citizen participation, undertaking public education, and conducting other necessary activities at the community and neighborhood level.

Certain new and innovative management institutions, with either single or multiple missions, are being tried throughout the Nation. Quasi-governmental public organizations, such as stormwater drainage utilities and lake management districts, are being designed to operate under specific objectives that directly impact watershed management. Various approaches are reported for agriculture (Bailey and Waddell, 1979; Holmes, 1979) and for urban sources (Thurrow and Earley, 1975; Kaiser et al., 1974). General documentation of institutional approaches for water quality management and their legality are also reported (Government Finance Research Center, 1980b; Environmental Law Institute, 1977). The Great Lakes Program, under EPA's guidance, has also implemented a variety of institutional approaches, with a range of results (U.S. EPA, 1978c).

Regardless of the ability of institutions to administer various aspects of watershed management, designation of a single overall management agency or organization may be necessary (Ford and Papke, 1977) to:

1. Prevent overlap in planning, control, and management activities, and to make optimal use of available resources.
2. Act as a single coordinating point for focusing watershed activities.

3. Serve as the repository for watershed and lake information useful in management activities.
4. Monitor progress in lake restoration and watershed implementation activities.
5. Be responsible for managing any kind of technical and financial assistance provided from outside sources.
6. Minimize negative impacts in areas other than water quality management.
7. Be responsible for adjusting the management program as progress is made toward water quality goals and as conditions change which may affect the implementation plan.

To be successful, general management must include the three basic functions of program supervision and coordination, fiscal management, and continuing planning. However, each function may contain a number of specific elements or activities that may be shared in various ways between a single management institution and the decentralized operating agencies, or among a group of decentralized agencies. Obviously, the size and complexity of a watershed management program and available resources will dictate the character of an organization, its powers and abilities.

4.5.2 Institutional Evaluation Methodology

Institutional/management arrangements should receive consideration similar to that applied for the assessment of pollutant loads, evaluation of control measures, and selection of a technical strategy for management. The ultimate objective of watershed management program design is the proposal of an integrated package of physical controls, implementation measures, and institutional arrangements that will control the entry of pollutants into the lake. Institutional arrangements should be evaluated both separately and in conjunction with the physical and implementation measures to successfully integrate all components into a "workable" program.

Specific guidelines are inappropriate for institutional planning because of the high degree of site-specificity of a local watershed, the institutions, and the individuals involved. However, the planning process and analysis should be managed within the scope of resources available, should involve both policymakers and the public, establish a need for action, fully integrate the various disciplines contributing to the effort, emphasize the simplest analysis methods needed, fully consider financial aspects, and assign institutional responsibilities as appropriate (Government Finance Research Center, 1980a).

The procedures for review, evaluation, and selection of an appropriate institutional framework

are similar to those for physical controls, and include the following elements:

1. Review of existing watershed institutional/management framework.
2. Specify "ideal" institutional arrangements.
3. Evaluate existing agencies and organizations for:
 - a. Effectiveness in accomplishing water quality objectives.
 - b. Potential for expanded or modified future role.
4. Evaluate new and innovative institutional structures.
5. Select most "implementable" institution(s) for implementation.

Procedures for review, evaluation and identification of an appropriate institutional framework are discussed in Appendix C.

4.5.3 Examples of Management Institutions

Management institutions operating in a watershed management program may range from the older, well-established government agencies at the Federal, State, and local levels to new agencies or organizations. The well-established government agencies operate under a hierarchy with geographic jurisdictions and program objectives that rarely coincide exactly with those of a watershed and its management program. The new institutions may be established with more limited and specific responsibilities oriented to a watershed, its boundaries, and its residents and users.

There are a growing number of examples of management institutions which could serve as models or provide guidance for addressing local situations. Some examples are identified and discussed briefly in Appendix C.

5.0 IN-LAKE RESTORATION TECHNIQUES

5.1 Introduction

A fundamental objective of the Clean Lakes Program is to maximize the public benefits which can be obtained with the funds available. One aspect of the strategy for attaining that objective, discussed in Section 6.0, is to select projects which will yield long-term improvements in and/or protection of lake quality. This means that funding preference will be given to projects which eliminate pollutant sources and reduce pollutant loading, in contrast to projects relying solely on in-lake activities to ameliorate the symptoms of lake degradation without attacking its causes. In other words, EPA emphasizes lake watershed management in making funding decisions.

This policy does not mean that in-lake restoration techniques will not be supported. Dredging, aeration, nutrient inactivation, and the other techniques described in this section are important lake restoration tools in two situations:

1. When sufficient pollutant reduction is being accomplished in the watershed to allow desired lake quality to be maintained, but recovery from the degraded condition will be slow or will not occur simply as a result of watershed management.
2. When material accumulated in the lake constitutes a significant source of pollutants which is independent of controllable activities in the watershed.

The first situation may be seen in a lake which has become so shallow because of sediment transport from the watershed that rooted aquatic plants occupy much of its surface area and preclude swimming and boating. To maintain long-term lake quality, erosion and sedimentation must be controlled. However, when that is accomplished, the plants may continue to persist due to shallowness and accumulated nutrients in the sediment. Dredging to a specific depth could create a light-limited environment and remove nutrients so that plants could not

reestablish themselves. This would eliminate them, and erosion control will then prevent their recurrence.

An example of the second situation is a lake which contains a layer of nutrient-rich bottom sediments from which phosphorus, the lake's limiting nutrient, is returned to the lake column in sufficient quantity to promote nuisance algal blooms. If there are no existing large phosphorus sources in the watershed, or if the most cost-effective means of reducing phosphorus loading to acceptable levels is to eliminate the in-lake source, dredging or bottom sealing could be supported by the Clean Lakes Program.

The first situation is the one most often encountered, where in-lake techniques are applied in conjunction with watershed management. The other two are, in a sense, special cases of the first, since they imply that pollutants from the watershed have already been properly managed and will not cause a quick recurrence of water quality problems. The basic principle to be kept in mind in any lake program is that long-term, cost-effective improvement is almost always associated with management of the land and diversion or treatment of polluted incoming water.

The purposes of this section are to introduce in-lake techniques on which sufficient evaluation has been conducted to enable definitive conclusions, and review the state of knowledge on their applicability and effectiveness in lake protection and restoration. The reader is urged to consult the scientific articles referred to in the text. In particular, the following recent papers are fundamental to an in-depth understanding of the various techniques: aeration, Pastorok, et al. (1980); dilution/flushing, Welch (1980); dredging, S.A. Peterson (1980); nutrient inactivation, Cooke and Kennedy (1980); biological controls, Cooke, (1980a); sediment covering, Cooke (1980b); lake level drawdown, Cooke (1980c) and Schuytema (1977); harvesting, Burton, et al. (1979). Most of these are reviews or research on lake restoration

conducted or supported by EPA's Office of Research and Development, Corvallis Environmental Research Laboratory, Corvallis, Oregon.

Herbicides have not been reviewed or described in the manual. There are no registered chemicals which provide lasting control of weeds and algae, and in most cases these toxic chemicals release nutrients, cost a large amount for very temporary relief, and require the presence of a licensed operator who may not be available when needed. Moreover, they can leave persistent residues which can be harmful to non-target species. Reliance on herbicides will require regular, expensive re-treatment, and attendant undesirable side-effects. Herbicides are specifically not recommended as the basis of any long-term plan to obtain relief from nuisance weeds and algae. If they are ever applied, it is urged that only EPA registered chemicals be used, and that a licensed, insured operator be employed.

As a guide to parts of this section most appropriate to individual lake improvement needs, lakes which have problems of excessive shallowness and/or rooted aquatic plants may benefit most from dredging, harvesting, sediment covering or lake level drawdown, while lakes which have excessive algae may respond to dilution/flushing, nutrient inactivation, or aeration. In some cases a combination of procedures may prove to be most beneficial. One procedure, biological controls, is relatively new; the introduction of organisms to lakes to control excessive vegetation remains highly experimental.

5.2 Aeration and Artificial Circulation

In stratified eutrophic lakes, the amount of organic matter that enters the hypolimnion is very large (from dead algae, weeds, animal feces, etc.). Bacterial decomposition consumes the dissolved oxygen shortly after thermal stratification in the spring, and oxygen is not restored to these waters until after lake circulation in the fall. There are a number of undesirable consequences of low or zero oxygen in the hypolimnion. Plant nutrients are released from bottom sediments, and compounds such as methane, iron, manganese, and hydrogen sulfide accumulate. The nutrients may be mixed into the upper, lighted epilimnion at turnover and stimulate algal blooms. Water withdrawn from the hypolimnion for drinking or industrial use may have undesirable taste and odor. The deep, cold water becomes unfit for survival of cold water fishes such as trout and salmon, and for benthic invertebrates. Only a few organisms can tolerate anoxic conditions for prolonged periods, and fish generally do not thrive in habitats where dissolved oxygen is less than 5 mg/l.

Hypolimnetic aeration introduces oxygen to the hypolimnion only, while artificial circulation mixes the entire water column. These tech-

niques free the water of taste and odor, improve the fishery and/or prevent winter fish kills, and attempt to control algae by either controlling nutrient release from bottom sediments by introduction of oxygen, or by circulating cells to depths where low light will limit growth. In hypolimnetic aeration, air or oxygen is injected into the deep water without disrupting thermal stratification, whereas in artificial circulation air is introduced with sufficient force to overcome the density differences between the two layers so that the entire water column circulates.

These two lake improvement procedures have been described in detail with regard to design, effectiveness, and shortcomings by Lorenzen and Fast (1977) and Pastorok, et al. (1980). Hypolimnetic aeration can be accomplished by several devices described by Fast and Lorenzen (1976), but most commonly, compressed air is injected into the hypolimnion at the bottom of an air-lift system. Water is forced up a tube to the lake surface and then returned to the hypolimnion by the same tube (Figure 5-1). Oxygenation and loss of hydrogen sulfide, ammonia, and other gases to the atmosphere occur at the top of the air-lift tube at the lake surface. Pastorok, et al. (1980) and Fast (1979) report that this design is the least expensive and most efficient.

Hypolimnetic aeration is effective in removing compounds like iron and hydrogen sulfide, which add taste and odor to drinking and indus-

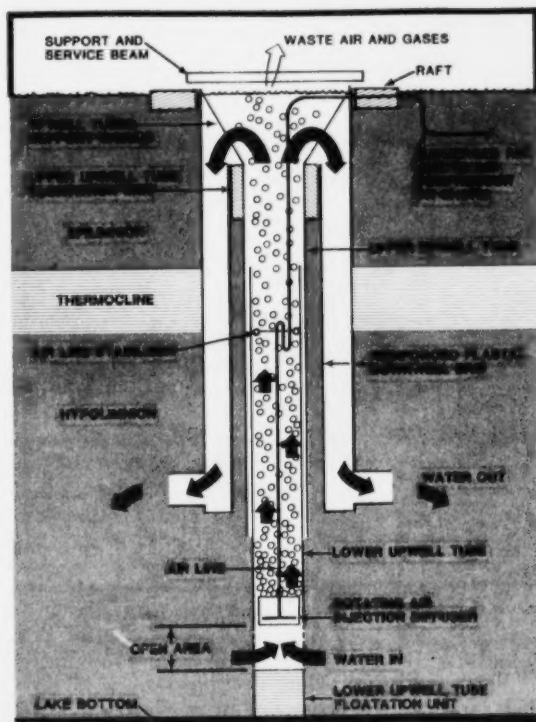


Figure 5-1. Hypolimnetic aeration system (Fast, 1979).

trial water. Sufficient aeration may lower phosphorus concentration in the hypolimnion as well, but there is little documentation regarding a simultaneous decline in algae in the epilimnion. However, zooplankton (grazers on algae) might invade the oxygenated hypolimnion and perhaps escape the intense visual predation by fish during the day in the epilimnion. At night these grazers could return to the epilimnion and thus exert some control over algal biomass.

Hypolimnetic aeration can create a cold water fishery, or a "two-story" fishery with warm water species in the upper water and cold water species in the deep. Winter fish kills may be prevented if sufficient organic matter is consumed in an oxygenated hypolimnion in the summer and oxygen demand under the ice in winter is thereby lowered. Hypolimnetic aeration is used for prevention of winter fish kills and general improvement of fisheries and not for control of algal blooms.

Artificial circulation is usually accomplished by injecting air at a high rate (about $9.2 \text{ m}^3/\text{minute}$ per 10^6 m^2 of lake surface or $1.3 \text{ ft}^3/\text{acre}/\text{min.}$) into the deepest portion of the lake, using a perforated pipe (Figure 5-2). The

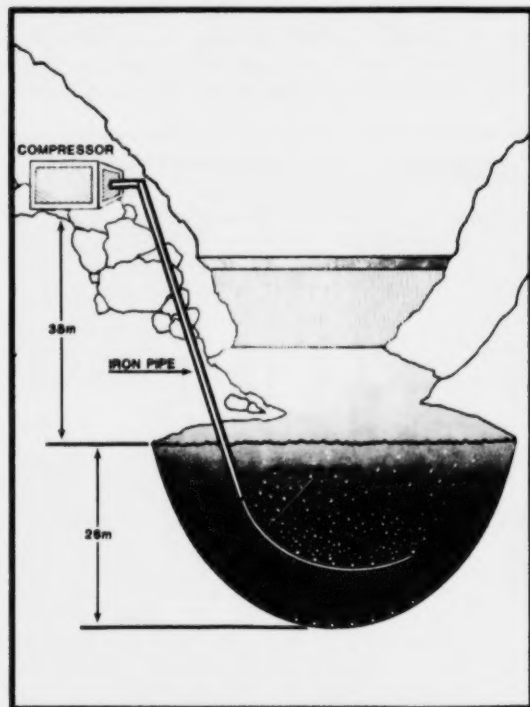


Figure 5-2. Artificial Circulation (Fast, 1979).

circulator is used intermittently once circulation has been achieved (identical temperature from top to bottom). A frequent problem is insufficient rate of air flow. Pastorok, et al. (1980) recommend that circulation be accomplished early

in the season before full thermal stratification is achieved to avoid the circulation of nutrient-rich hypolimnetic waters which could bring about an algal bloom.

Artificial lake circulation or destratification, like hypolimnetic aeration, will remove those compounds which give taste and odor to drinking water. The effect of circulation in controlling algae has been variable, even though phosphorus concentration may decline. Pastorok, et al. (1980) report that in only 19 of 30 cases in which mixing was complete was algal biomass reduced. In part this failure to achieve any control of algae may be caused by factors which increase nutrient release from lake sediments, such as an increase in density of burrowing organisms, higher water temperature, or accelerated decomposition of organic matter after circulation. There can be a shift in dominant algal species from nuisance blue-greens to more acceptable green algae, even if the total amount of algae does not decline. If zooplankton do increase by escaping visual fish predation in deeper, dark waters, then their nighttime grazing may control algae somewhat.

Artificial destratification may benefit a warm water fishery by expanding the habitat and the abundance of fish food organisms, but there is little documented evidence of this.

Several adverse effects may occur with artificial destratification, according to Pastorok, et al. (1980). These include increased turbidity if sediments are disturbed, stimulation of an algal bloom by bringing nutrients into upper lighted waters, creation of gas bubble disease in fish from increased dissolved nitrogen concentration in the water, and fish kills from a sudden decrease in dissolved oxygen in the epilimnion following the introduction of oxygen-free hypolimnetic waters to the rest of the lake. Most adverse effects result from improperly executed aeration or circulation, such as placement of the air diffuser too far from the lake bottom, undersizing or oversizing the capacity of the aerator, or mixing of oxygen-free water with a small epilimnion.

In summary, both techniques succeed in removing taste and odor, and in creating new fish habitat. Limitation of algal growth may not occur.

5.3 Dilution/Flushing

These lake improvement techniques are aimed at reducing the quantity of nuisance blue-green algae by either flushing them out of the lake with large volumes of introduced water, or by controlling algal population growth rate by introducing enough low nutrient water to reduce the concentration of a limiting nutrient. Effective dilution requires that the inflow water have a much lower concentration of the limiting nutrient than the lake water. For flushing to be suc-

cessful, the water exchange rate must approach algal growth rates (i.e. complete water replacement every 2 to 3 weeks). Domestic water supply, artesian wells, and nearby rivers are among the possible water sources. Flushing requires high volumes of water, and the outlet structure of the lake must be examined and found adequate before proceeding. Erosion around dams could cause dam collapse. Moreover, high flows from the lake's outlet stream may have undesirable effects downstream. Finally, seepage lakes may not have an outlet, or the outlet may be very small and inadequate for the volume needed to accomplish sufficient dilution or flushing.

There have been very few reported uses of these techniques, partly because of the unavailability of low nutrient water, or of water sufficiently free of toxins to be introduced to a lake. However, dilution/flushing operates as a natural control of algae in many lakes. Dilution and flushing have been reviewed by Welch (1979, 1980). The dilution technique has been shown to be effective in controlling blue-green algae in Moses and Green Lakes, Washington (Welch, 1980). In one season at Moses Lake, the algal growth rate was reduced after dilution water exceeded about 50 percent of lake volume. Blue-green algae growth declined as the amount of dilution increased, and they ceased to grow when lake water remaining reached 20 percent. This response was due in part to a decrease in nitrogen content of the lake and to instability in the water column which favored non-buoyant algae, such as diatoms and green algae. But, unless water is continually added, blue-green blooms will return. Welch (1980) suggests that dilution water be added at continued low rates rather than a large amount followed by little or none. While blue-greens' growth decreased as dilution increased, diatom growth rate often improved, and Welch speculates that the effect of dilution in Moses Lake was not caused by nutrient limitation but by dilution of inhibitory substances excreted by blue-greens.

Cost of these techniques depends upon the supply of water, its proximity to the lake, and the availability of facilities. Welch (1980) states that if domestic water is available, then lake improvement may be possible for less than \$100,000 for construction and first year maintenance and operation. Costs should be far less if artesian wells can be drilled along the lake shore.

5.4 Phosphorus Precipitation or Inactivation

Nutrient inactivation/precipitation is a lake improvement technique which has been used exclusively to control or lower the concentration of phosphorus in the water column and thereby control the amount of planktonic algae. Inactivation is an attempt at long-term control by stop-

ping the release of phosphorus from lake sediments, while precipitation is the removal of phosphorus from the water column. Inactivation is almost always the recommended procedure. The element most often used to attempt inactivation or precipitation is aluminum. This technique has been reviewed in depth by Cooke and Kennedy (1980a,b) and Kennedy and Cooke (1980); their reports contain technical details of dose, side-effects, case histories, costs, and application procedures.

Nutrient inactivation or precipitation can only be effective in lakes from which significant inputs of nutrients have been eliminated. The techniques are presently used only for algal control, not for control of rooted aquatic plants. Both ponds and lakes have benefited from it, particularly those which flush slowly and stratify. There has been little published experience with the technique in thermally unstratified, highly-mixed lakes. Lake size does not seem to be an important factor since large areas have been treated [120 hectares (300 acres) in Lake Annabessacook, Maine].

Adding liquid aluminum sulfate and/or sodium aluminate has been the most frequently used method of precipitating or inactivating phosphorus. These salts work in three ways: by forming aluminum phosphate, by entrapping phosphorus-containing particles in the water column, and by adsorbing phosphorus to the surface of aluminum hydroxide (the main chemical product of the precipitation reaction). The aluminum hydroxide is formed as a floc, or visible particles, in the water. The floc settles through the water column (removing suspended material on the way), and covers the sediment with a blanket of aluminum hydroxide. Water so treated becomes almost instantly clear, and if sufficient aluminum hydroxide has been deposited on the sediments, it has a sealing effect. Phosphorus recycling from the sediments is greatly reduced, phosphorus concentration in the water remains low, and the water continues to be clear. The floc eventually (several months) consolidates with the sediments and is no longer visible.

The amount of aluminum added to the water is the factor which separates phosphorus precipitation from phosphorus inactivation. In the former procedure, just enough aluminum is added to surface water to remove phosphorus from the water column. The exact amount is determined in jar tests. In such cases, dose is small, little if any control of release from lake sediments is achieved, there are few risks of side-effects, and long-term control of algae usually does not occur. Precipitation or phosphorus removal is recommended only for situations in which the sediments are not a significant source of phosphorus. Phosphorus inactivation is recommended for most other situations, since

phosphorus release from eutrophic lake sediments usually is a major source of this essential element for growth of algae and may delay lake recovery for many years after external sources have been controlled or diverted.

Phosphorus release is controlled for long periods (years) by the aluminum hydroxide layer, but serious side-effects, especially low pH and high dissolved aluminum concentration can occur if too much aluminum sulfate is added. Cooke and Kennedy (1980a) and Kennedy and Cooke (1980) have found that this problem can be avoided and long-term control of phosphorus release still achieved if aluminum sulfate is added to the deep water of the lake until the pH falls to 6.0. This pH is not excessively low for aquatic organisms, and dissolved aluminum will be at levels well below those which could be toxic to fish. In the case of softwater lakes, a mixture of sodium aluminate and aluminum sulfate can be used; the pH decline is thereby avoided entirely, and no toxic level of dissolved aluminum develops. A simplified procedure for dose determination has been described by Kennedy and Cooke (1980).

Nearly all application equipment is modeled after the barges used at Horseshoe Lake, Wisconsin in 1970 (J. O. Peterson, et al. 1973). An on-board tank is used to store liquid aluminum sulfate (two tanks if sodium aluminate is also to be added), and the material is pumped from the tank, along with water, to an application manifold (see Figure 5-3). Some have applied the chemical to the lake surface, particularly if precipitation of phosphorus is the objective, while others have lowered the manifold to deeper water, usually to control phosphorus release from sediment. Modifications of this procedure have included an on-shore storage tank and an across-the-lake pipeline to refill (Cooke, et al. 1978). Others have suggested that small lakes or ponds could be treated by spraying from shore with high velocity pumps. Control of algae in ponds (May, 1974) has also been achieved by suspending blocks of ferric alum in the water column, an application method which should receive additional study.

Adequate cost analyses are not available, in part because of the great variability among treat-

ments and the changing costs of chemicals and labor (Funk and Gibbons, 1979). Cooke and Kennedy (1980a) report that labor was 1 to 2 man-days per hectare, and equipment and chemical costs ranged from \$400 to \$500/hectare in the small sample of lakes for which data are available.

The longest reported monitoring to assess longevity of phosphorus control after inactivation with aluminum sulfate is at Dollar and West Twin Lake in Ohio (Cooke, et al. 1978; Cooke and Kennedy, 1980a,b), where phosphorus concentration and algal biomass were reduced for at least 6 and 5 years, respectively.

No deleterious effects to animals have been reported in lake treatments in which dose ranged from 0.5 to 26 grams of aluminum per cubic meter. However, there was a significant change in the species composition of the algae and zooplankton following the treatment at West Twin Lake, Ohio (Cooke and Kennedy, 1980a). This effect may be caused by changes in their nutrition and not by toxicity. Lake waters have remained so clear in some treated lakes that significant increases in rooted aquatic plants have occurred.

In summary, inactivation of phosphorus release from sediments with aluminum salts appears to be a successful technique for lowering phosphorus concentration to levels limiting to algal growth when used in conjunction with a program to manage phosphorus income from the watershed. Costs are not well documented, but the technique has longevity (at least 5 to 6 years) and there are no known deleterious side-effects to biota if proper procedures for dose determination and application are followed.

5.5 Lake Level Drawdown

Lake level drawdown is a multipurpose lake improvement technique. It has been used to attempt control of nuisance rooted plants, to manage fish, to consolidate flocculent sediments by dewatering, to provide access to dams, docks, and shoreline stabilizing structures for needed repairs, to permit dredging using conventional earthmoving equipment, and to facilitate application of sediment covers. The procedure is often an inexpensive one which can be effective in aquatic plant control where susceptible species are present and where rigorous conditions of dry cold or heat can be achieved for 1 to 2 months. Cooke (1980c) provides a detailed review of the technique.

Two case histories will serve to describe drawdown's effectiveness in controlling rooted plants. Beard (1973) reported that 42 percent [303 hectares (750 acres)] of Murphy Flowage, Wisconsin was obstructed to the extent that fishing was not possible. *Potamogeton robbinsii* (Robbin's pondweed) was the dominant nui-

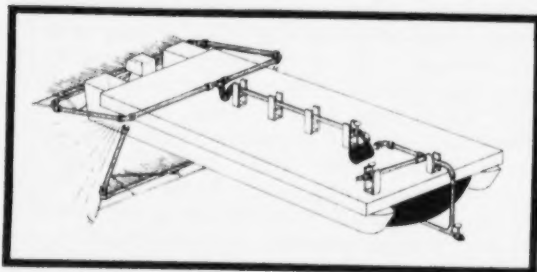


Figure 5-3. Chemical-dispensing system and barge (Battelle, Pacific Northwest Laboratories).

sance plant, and the sub-dominants were *Nuphar* sp. (water lily), *Ceratophyllum demersum* (coontail), *Potamogeton natans* (floating-leaf pondweed), and *Myriophyllum* sp. (water milfoil). In 1967 and 1968 the level was lowered 1.5 meters (5 feet) from November through March, and restored in April. There was 92 percent reduction in area covered by plants after drawdown, and all plant species were controlled or eliminated. Fishing became possible in 87 percent of the area previously covered by the plants. In 1969 *Potamogeton natans*, *Megalondonta beekii* (bur marigold), *Najas flexilis* (naiad) and *Potamogeton diversifolius* became abundant but had a less serious effect on fishing than previous plants. In this case, nuisance rooted plants were controlled by a winter exposure of sediments, and areas previously closed to fishing were opened. However, an algal bloom occurred in August of the year after drawdown.

Lantz, et al. (1964) and Lantz (1974) used drawdown in Louisiana reservoirs to control aquatic plants and manage fish. Susceptible plant species were controlled but resistant ones increased in abundance. Winter drawdowns removed sunfish and shad and summer drawdowns prevented spawning. Fish abundance and size increased in reservoirs where there were 5 or more consecutive years of fluctuation of water level.

There is little information about the effectiveness of drawdown in controlling common aquatic plants. Table 5-1 lists those species which have been clearly shown to be controlled, those which have no response, and those which increase after drawdown. Cooke (1980c) summarizes available information on the responses of 63 aquatic plants to drawdown.

Table 5-1 emphasizes the need to identify nuisance plants before attempting to achieve control by drawdown and exposure. The technique is species-selective, and several workers have reported that if species resistant to drawdown

are present, they can spread rapidly upon refilling.

Failure to achieve plant control can result not only from the presence of resistant species but also from failure to achieve sufficient dewatering of lake sediments. Without adequate dewatering, vulnerable reproductive structures are not sufficiently exposed to lethal freezing or heat. This problem is especially likely to arise in seepage lakes, where sediments may remain moist throughout winter or summer months, allowing otherwise susceptible plants to survive. It is not known whether a winter drawdown is more effective than a summer one since there are so few quantitative reports about either.

Lake level drawdown may have other beneficial effects in addition to controlling nuisance rooted vegetation. Fishing is said to be improved by removal of vegetation, and by concentrating small fish into smaller volumes of water where predation by gamefish can be more intense. Flocculent lake sediments can lose enough water to become hard and capable of supporting a standing swimmer. Turbidity and concentration of nutrients for algae, which may be partly caused by disturbance of flocculent sediments by waves and motorboats, may be reduced. Installation of sediment covering (see section 5.6) and repair of dams, docks, and beaches may be greatly facilitated by a drawdown. Vegetation maintained to attract waterfowl, such as emergent rooted plants, may be enhanced by drawdown. Finally, because plants can contribute to the recycling of essential algal nutrients from the sediments to the water column, plant destruction by drawdown may retard this process.

Several negative aspects of lake level drawdown have been observed. Blooms of nuisance algae have occurred in lakes and reservoirs after drawdown, possibly caused by mineralization of nutrients in organic-rich sediments or to an absence of some competitive effect from rooted plants. Some workers have feared fish kills, particularly during a summer drawdown when oxygen consumption in a smaller volume of water could deplete oxygen, but there have been few reports of significant fish mortality following drawdown. One negative aspect of drawdown which may affect fish is the destruction of food animals which live in shallow lake sediments. Hardening of exposed mud may also retard re-invasion of these animals, but reports of enhanced fishing in Louisiana reservoirs suggests that these potential problems may not be of significance. Failure of the lake or reservoir to refill may be caused by insufficient watershed drainage area, drought, or delay in closing the dam until too late in the season. Continued low lake levels, especially during summer months, could affect water levels in potable water wells.

In summary, lake level drawdown can effec-

Table 5-1
Responses of Some Common Nuisance
Aquatic Plants to Lake Level Drawdown

- | |
|--|
| A. Increased in Abundance After Drawdown |
| 1. <i>Alternanthera philoxeroides</i> (alligatorweed) |
| 2. <i>Najas flexilis</i> (naiad) |
| 3. <i>Potamogeton</i> spp. (most species of pond weed increase or do not change) |
| B. Decreased in Abundance After Drawdown |
| 1. <i>Chara vulgaris</i> (muskgrass) |
| 2. <i>Eichhornia crassipes</i> (water hyacinth) |
| 3. <i>Nuphar</i> spp. (water lily) |
| C. No Change or Clear Response After Drawdown |
| 1. <i>Cambomba caroliniana</i> (fanwort) |
| 2. <i>Elodea canadensis</i> (elodea) |
| 3. <i>Myriophyllum</i> spp. (milfoil) |
| 4. <i>Utricularia vulgaris</i> (bladderwort) |

Source: Modified from Cooke, 1980c.

tively control susceptible nuisance plants and can provide several other important lake improvement benefits. Negative effects are possible but can be minimized by attempting control of only susceptible species and by observing other important factors, such as adequate water for prompt lake refill. Several years of drawdown may be required, particularly in areas where wet, mild winters occur and dry freezing conditions are not achieved throughout the exposed areas.

5.6 Sediment Covering

Application of materials over lake sediments has been used primarily to control growth of rooted plants and to retard the release of plant nutrients to the water column from nutrient-rich mud. Among the materials which have been used are polyethylene sheeting, fly ash, and fiberglass screens. The following paragraphs discuss some of the most widely used materials. Further details are available in a review of the topic by Cooke (1980b).

5.6.1 Fly Ash

The particles collected by electrostatic precipitators in the smoke stacks of coal-fired power plants are known as fly ash. Fly ash has been evaluated as an agent to retard phosphorus release from lake sediments and thereby control algal production. Large amounts are produced annually in the United States and elsewhere, and part of the disposal problem could be alleviated if the material were found to be effective in lake improvement. Fly ash will adsorb phosphorus, and because of its cement-like properties when mixed with water, it will form a seal over lake sediments.

Fly ash has been evaluated in laboratory and field experiments, primarily by Tenney and Echelberger (1970), Yaksich (1972), and Theis, et al. (1979). While laboratory studies revealed that fly ash might be effective in lakes, it was suspected that the high pH created when it is added to water, plus the possible release of toxic heavy metals (such as boron, molybdenum, selenium, arsenic, and mercury), could create deleterious conditions for lake flora and fauna. The two reported field tests of fly ash (Hampton, 1972; Theis, et al. 1979) caused extensive mortality among fish and fish food organisms associated with an apparent increase in heavy metal concentrations. Further experiments may explain these observations and lead to a method of using fly ash without adverse impact to lake ecosystems, but at the present time, it should not be used in lakes.

5.6.2 Sheeting Materials

Polyethylene, polypropylene, fiberglass and other sheeting materials have been tested over lake sediments to control nuisance rooted plants. While expensive, they can be highly effective and have the important advantage of be-

ing semi-permanent. The most recent experiments with these materials, reviewed in Cooke (1980a), include Mayer (1978), Armour, et al. (1979), Cooke and Gorman (1980), and Perkins, et al. (in press).

Armour, et al. (1979) examined five compounds: black polyethylene sheets, polyethylene tarps, Hypalon (a synthetic rubber material), PVC (polyvinyl chloride), and Permealiner (a semi-permeable black polypropylene). These materials have to be weighted and perforated to allow escape of gases which would otherwise lift them from the lake bottom. Plants often grow through the perforations. Black polyethylene, polyethylene tarps, and Hypalon were hard to handle because of weight and/or buoyancy, and the black polyethylene sheeting was easily dislodged by waves or boats. Silt can accumulate on the sheeting and permit new plants to grow. Costs ranged from \$12,500/hectare for black polyethylene to \$59,400 for Hypalon, making their use prohibitive except in small areas.

PVC-coated fiberglass screen with a mesh size of 62 apertures per cm^2 ($400/\text{in}^2$) has been evaluated by Mayer (1978) and Perkins, et al. (1980), and both found it to be easily applied and effective for the duration of emplacement. Regrowths, even after removing the material after just one month of cover, were not great. This suggests that small amounts of screen might be used to treat large areas by moving the screen from one place to another. The screen is anchored to the sediments with weights and/or stakes and is permeable to gases. As with other screens, silt may eventually accumulate on it and regrowth occur. Mayer suggested periodic removal and repositioning to overcome growth on the screen. Costs (1980) are about \$22,000 per hectare (\$8,700/acre).

Another material which is permeable to water and to gases from the sediments and is effective in controlling rooted aquatic plants, is black polypropylene (Cooke and Gorman, 1980). This material is applied like fiberglass screen, and cost \$6,500 per hectare (\$2,600/acre) in 1978.

Impervious sheeting, such as black polyethylene, has been suggested for controlling nutrient release from lake sediments, but recent experiences with impervious sheeting indicate that expense, difficulty in application, and impermeability to gases would make this use impractical. Clay and sand have also been suggested as possible agents to retard weed growth and nutrient release, but so few experiences with these materials have been reported that recommendations for their use are as yet impossible.

In summary, sediment covering retards rooted plant growth, but only screen and sheeting materials have been shown to be both effective and ecologically safe. Because most of these materials are very expensive, it is recommended that

they be used selectively — around docks, beaches, or boating areas, for example — rather than in the entire shallow area of the lake. Unless siltation is rapid, one installation may last several years before plant growth can begin on top of the sheeting.

5.7 Sediment Removal

One of the most frequently prescribed treatments for lakes with excessive shallowness and/or rooted nuisance plants is sediment removal or dredging (Figure 5-4). This procedure has also been thought to be important in long-term control of nuisance algae by removing nutrient-rich lake sediments, and valuable as a means of removing sediments which have been contaminated with toxic materials. Reviews of this lake improvement technique have been conducted by S. A. Peterson (1979, 1980), from whom much of the following discussion is drawn.

Sediment removal is an expensive operation, requiring that the lake manager consider several important questions before proceeding. Some of them require extensive research at the site in question, but such research is an important first step in assuring an effective operation.

1. What are the sources of silt and plant nutrients to the lake, and how fast are they entering the water column?

There are very few lakes for which an adequate measure of the inflow and outflow of silt has been made, yet this step is essential. A sediment removal operation will prove to be short-lived and futile if significant sources of silt remain after dredging. The first steps in im-

provement of excessive shallowness by sediment removal are to develop a plan to control silt income and to estimate how fast the lake will refill with sediment after the removal operation.

It was once thought that problems with algae in lakes could be solved solely by diverting nutrients. We now know that lake sediments can be an important source of nutrients to algae, and this is the basis for the lake improvement technique known as nutrient inactivation. Removal of these sediments by dredging can also bring about relief from nuisance algae. But before this is done, it is important to determine the significance of lake sediments as a contributor of nutrients to the water column in relation to other sources. Thus an annual budget of nutrients should be determined and supplemented with experiments on nutrient release, before removing sediments to control algae. Either of these procedures will involve estimating the significance of internal and external sources of nutrients to the water column. (See Section 10.0 and Appendix E for guidance on nutrient budget calculations.)

2. If lake sediments are an important nutrient source, then how much will have to be removed? If rooted plants are a problem as well, what new lake depth should be attained by sediment removal to control them through light limitation?

The first question may be answered by determining nutrient release potential of lake sediments from several depths in a sediment core. Many lakes have had a recent history of excessive silt and nutrient income, represented by a relatively thin layer of nutrient-rich sediments.

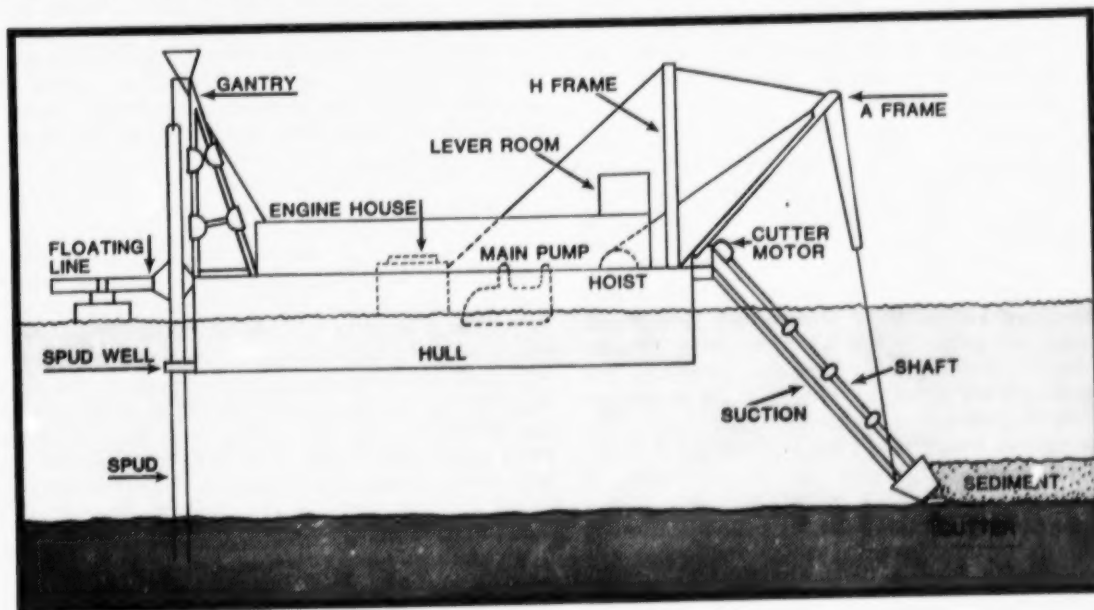


Figure 5-4. Cutterhead dredge (Peterson, 1979).

Below these sediments may lie soils of far less enrichment potential, and sediment removal for algal control could stop there. A similar approach might be taken for toxic substances.

Many aquatic biologists believe that light penetration is one of the most important determinants of the depth to which rooted aquatic plants will grow. To control them by sediment removal means that water clarity measurements must be made to determine maximum depth of growth. At present, the Wisconsin Department of Natural Resources (S. A. Peterson, 1980) estimates the maximum plant growth depth by the equation:

$$\text{Maximum depth of growth} = 0.83 + [1.22 \times \text{average summer water clarity (Secchi disk in meters)}]$$

3. What negative environmental problems may be encountered with sediment removal, both in the lake and at the sediment disposal site?

Resuspension of fine particles and plant nutrients associated with them may increase algal growth and oxygen consumption. Toxic substances may be released to the water column. Sediment removal, particularly if the entire lake basin is dredged, will also destroy the community of benthic organisms which are important to the fish community. However, this latter problem appears to be temporary, and enhanced fishing may occur after re-establishment of the fish food organisms.

At the disposal site, problems with dike failure and insufficient capacity are common. The discharge from the site may be high in nutrients or toxic substances, thus requiring treatment. It should be noted that fill permits are required by the Army Corps of Engineers where an adjacent wetland or waterway is to be used for disposal.

4. What sediment removal techniques are best, which lakes will benefit most, and what will it cost?

Lake level drawdown (see subsection 5.5) can be used to expose lake sediments for removal by conventional earthmoving equipment. Exposure and drying has the additional advantage of hardening of flocculent lake sediments and causing some deepening.

Sediment removal is usually accomplished with a hydraulic dredge, fitted with a cutterhead. These can remove 1,000 m³ per hour (35,000 ft³/hour), but can also create turbidity and resuspension of nutrients and toxic materials. More expensive equipment (in terms of costs per unit of material removal per time) is available where avoidance of resuspension is required.

Lakes which are good candidates for sediment removal include those for which deepening will immediately restore an impaired recreational benefit such as boating, and those in which surficial sediments are significant nutrient

sources. Whether sediment removal can be accomplished at reasonable cost depends on whether adequate disposal areas are available. Sometimes productive uses can be made of the material which is removed, offsetting some of the project costs. In few cases will cost-effective sediment removal be possible where control of silt and nutrients from external sources has not been achieved. With some lakes, particularly those where the drainage basin is 20 or more times the lake area, sufficient control of erosion and nutrients from the land may not be possible.

Costs of sediment removal vary widely from project to project, and range between \$1.00 and \$15.70 per cubic meter (\$0.76 to \$12.00 per yd³). Peterson (1979) estimated mean cost by geographic region, since disposal costs and other variables change regionally. They are: Great Lakes area, \$1.34/m³ (\$1.02/yd³); Northwest, \$2.36/m³ (\$1.80/yd³); Central States, \$2.49/m³ (\$1.90/yd³); and Northeast, \$5.63/m³ (\$4.30/yd³). Lakes with high silt income and deposition may benefit in the short run, but the treatment is not likely to be cost-effective.

Is sediment removal effective? Peterson (1980) examined the results of 64 removal projects in the United States. As with many other lake improvement procedures, extensive published information is not as yet available, but certain conclusions are possible. Removal for deepening purposes is effective, but the rate of transport of new materials to the lake will determine duration of effectiveness. Controlling rooted plants by deepening is not well documented. Where toxic substances are involved, costs may be more than double those for uncontaminated material because of the extra care required during removal and disposal to minimize release of toxics to surface or groundwater. Where removal to control nutrient release is the object, success will be directly related to control of external nutrient sources, and to the extent to which the sediments are an important contributor of nutrients to the water column.

5.8 Harvesting

Aquatic plant harvesting is a procedure to cut and remove (usually) vegetation, giving the lake user immediate relief from conditions impairing swimming, boating, and water-skiing. In few instances could harvesting, by itself, be called a lake restoration technique, since it does not affect external sediment and nutrient income or alter conditions for re-growth, such as shallowness and nutrient-rich lake sediments. As with any other in-lake technique, diversion of sediment and nutrients is essential for long-term lake improvement.

A commonly-used method for controlling excessive aquatic plants is herbicide treatment. Harvesting is at least as effective, is no more expensive, and has several distinct advantages

over the introduction of toxic chemicals. The procedure is target specific, and the time and place of harvesting are decided by lake users. The nuisance is immediately removed, and with it a certain quantity of plant nutrients. No poisons are introduced and no toxic residues remain. The lake can remain open during harvesting. The plants do not remain in the lake to decompose, remove oxygen, and release nutrients which may stimulate algae growth. Finally, the harvested weeds may be used for compost, mulch, methane production, etc.

There have been several recent reports about harvesting. Among them are Burton, et al. (1979), Carpenter and Adams (1977), Wile (1978), and a volume issued by the Institute for Environmental Studies at the University of Wisconsin (Madison) (1979). The following summary is drawn from these and other recent sources.

There are two general types of weed harvesting systems, those which cut plants, and those which cut and then remove the cut material. Low cost systems simply cut the vegetation; removal occurs after wind and currents move the floating vegetation to shore or to a barrier at the lake's outlet. This type of system is not recommended for lakes in which current is unpredictable (such as natural lakes and many impoundments) since the cut vegetation will ultimately sink, decompose, release nutrients, and consume oxygen. The other system cuts plants to a depth of about 1.5 meters (5 feet), and a conveyor removes the cuttings to a holding area on the harvester. Cut plants are then transported to shore by the harvester, or to a second vessel which takes them to shore while the harvester continues to cut. This system has a high initial cost but removes the vegetation from the lake at a rate of 1 to 3 hectares per day (4 to 6 acres).

Disposal of cut vegetation is often mentioned as a problem with harvesting. Apparently such problems rarely materialize, since many lakeshore residents have found the material to be valuable as mulch or compost. Wile, et al. (1978) report that experimental composting of milfoil (*Myriophyllum* sp.) resulted in a material which performed as well as standard greenhouse material, if high pH and salt content were lowered.

Harvesting can contribute to long-term lake restoration if the amount of nutrients removed in the cut vegetation exceeds the lake's net nutrient income. Burton, et al. (1979) provide a chart which shows how much plant material must be harvested for a given net phosphorus income. These data indicate that few eutrophic lakes can be restored by harvesting, although significant amounts of nutrients may be removed.

Regrowth after harvesting is usually delayed, and cutting and harvesting in one year tend to inhibit regrowth in subsequent years. Deeper cuts (nearer sediments) are more effective in

controlling regrowth, and multiple harvests in one season are better than a single early-season harvest. Thus, while harvesting is not often a long-term restoration method, it is clearly an effective lake improvement procedure which gives the user immediate access to the water without the problems associated with toxic chemicals.

The adverse effects of harvesting are not well-known, but a detailed report of our current knowledge is available (Carpenter and Adams, 1977) and is the basis of this summary. Harvesting constitutes habitat removal, and with it will come a reduction in species of the shallow area of the lake, particularly of animals such as snails, insects, and worms. The adverse impact on fish abundance appears to be slight (Wile, 1978) and only small fish are removed by the harvester (12 to 190 millimeters (0.5 to 7 inches) in length). Fish growth rates may increase, and fish may increasingly turn to algae grazers (zooplankton) instead of snails and insects. Algal blooms often occur after harvesting, and this may be caused by elimination of competition from the rooted plants, or by the removal of the algae grazers by fish. Another adverse impact may occur if vegetation at incoming streams is removed, since this vegetation probably removes nutrients and traps silt.

The cost of harvesting is greatly affected by the high initial cost of the equipment, but actually seems to compare favorably with herbicides. Several authors (see the Wisconsin report) have provided cost summaries. Costs per hectare range from \$173 to \$250 (\$70 to \$100 per acre), including labor (often well over half the cost), equipment, depreciation, and disposal. It should be noted that some American-made harvesting equipment has appreciated in price since purchase and also that operating costs go down as total harvest goes up. Costs can be reduced by designing an efficient cutting-transport plan and by purchasing equipment of size appropriate to the area to be harvested.

In summary, harvesting is effective in removing vegetation from lakes at the time and place desired by lake users, without the adverse impacts of herbicides. Costs are as low as for herbicide treatment and, with the possible exception of algal blooms, few adverse environmental impacts have been observed. Regrowth of plants is slowed by multiple cuts and the amount of plants in subsequent years is less. Harvesting is not a long-term lake restoration procedure unless the amount of nutrients removed with the vegetation exceeds the net nutrient income to the lake. It will provide immediate relief from nuisance plant growth and improve recreational uses of the lake.

It should be noted that the Clean Lakes Program considers harvesting to be a palliative approach to lake restoration in most cases, and therefore rarely eligible for financial assistance.

5.9 Biological Controls

Biological control of rooted aquatic plants and algae through the grazing activities of such organisms as fish or insects is one of the more recent experimental approaches to controlling excessive vegetation. With few exceptions, such as insect control of alligatorweed, biological control organisms are being viewed by aquatic scientists with caution since the introduction of exotic species to our Nation's waters could cause more problems than it solves. A well-known example is the common carp, which was brought to this country as a food organism but has probably caused as much damage as benefit. Scientists are therefore attempting to evaluate biological control species in a step-by-step fashion. Recent reviews of progress are provided in Schuytema (1977) and Cooke (1980a).

There are several different types of organisms presently being evaluated. A fungus which attacks water hyacinth (*Eichhornia crassipes*) has given good results, and insects have been released which give at least local control of both water hyacinth and alligatorweed (*Alternanthera philoxeroides*). This section, however, is confined to a discussion of two biological control methods, plant-eating fish and the manipulation of algal-grazer food webs, which are very promising as widely applicable means of controlling rooted plants and algae.

5.9.1 Herbivorous Fish

Tilapia mossambica (Mozambique mouth-brooder) and *T. zillii* have been suggested as possible controls of algae and certain rooted plants. They thrive only in warm water (greater than 10° C or 55° F). *T. zillii* has become a nuisance in Florida where it was introduced to test its ability to control rooted plants. These fish are not now recommended for controlling nuisance plants.

The white amur or grass carp (*Ctenopharyngodon idella* Val.) has been widely recognized in Europe and the United States as a plant control agent. This animal, a native of the Amur Basin in China and Siberia, consumes nearly all forms of vegetation and will also eat aquatic invertebrate animals. It grows rapidly, resists low temperatures, and can withstand low dissolved oxygen concentrations. The fish are usually stocked at a density of 100 to 250 kilograms per hectare (90 to 220 lbs/acre) of 1- to 2-year-old animals. It should be noted that complete eradication of plants may occur at the upper end of the stocking range, and the fish will then turn to shore grasses and invertebrate animals. They prefer soft plant tissues and filamentous algae and will avoid other plants such as milfoil (*Myriophyllum* sp.) unless there is no other choice.

Evaluation of the fish is now in progress throughout the United States. Grass carp have apparently succeeded in Red Haw Lake, Iowa

(Mitzner, 1978) and in various Arkansas lakes (Bailey, 1978). Rooted plants in the Iowa lake were reduced, fishing was said to be improved, and other potential side-effects such as algal blooms or interference with game fish did not occur. At present, only a few States allow possession of grass carp, except for experimental purposes.

However, because of the amur's spread by mail order and other means, and its promotion in the popular press (Whiting, 1980), the fish is found throughout the Mississippi River Basin, in the Ohio and Missouri Rivers, and in Florida and Georgia rivers. Most fish have come from Arkansas, a State in which they are the primary means of aquatic plant control in public waters. In spite of very stringent environmental requirements for successful reproduction, the grass carp is believed to be able to spawn in U.S. waters (Stanley, 1976).

Concern about grass carp comes from past experience with exotic animals such as the common carp. The role of grass carp in cycling of plant nutrients and thus in promoting algal blooms needs further research. In Europe, grass carp are notorious spreaders of fish disease (Bardach, et al. 1972). For example, Riley (1978) has found a tapeworm which is a serious fish pest in Europe in some grass carp from Arkansas. This finding suggests that the parasite could spread in this country. Some (Bailey, 1978) report no interference with game fish, while others (Forester and Lawrence, 1978) found significant declines in populations of bluegills and red-eared sunfish which were reared with grass carp. These and other concerns are sufficient to restrict the general use of grass carp for plant control until more research has been completed.

5.9.2 Biomanipulation

Shapiro, et al. (1975) coined the term "biomanipulation" to describe several lake improvement techniques, including altering the food web of the lake to favor that portion of the animal community which grazes on algae. Biomanipulation of food webs may be particularly useful in those situations where diversion of nutrient income is insufficient to lower in-lake concentration and thereby control algal growth.

The next level in the food web which depends on planktonic algae is the small, free-floating animal called zooplankton. This grazer is an important food source of bluegills, pumpkinseed, crappie, perch, shad, and other fish. In many lakes, huge populations of small fish exist and their predatory activities are so intense that few, if any, grazing zooplankton are found in the summer. There is good evidence to support the view of Shapiro, et al. (1975) that, in some water bodies, if the dominance of these small fish can be greatly reduced, grazing zooplankton can be-

come a significant force in controlling algae and higher water clarity will result. These grazing fish could be controlled or eliminated by introducing predators, or by eliminating all fish, followed by a balanced restocking. Elimination of all fish would have the additional advantage of removing carp (*Cyprinus carpio*), bullheads and other fish which recycle nutrients from the sediments to the water column. Biomanipulation is in the experimental stage at this time, but it is a promising approach which avoids the introduction of an exotic fish and could improve water clarity and sport fishing.

In summary, biological controls of nuisance

plants and algae are largely undeveloped lake improvement techniques. In the southern part of the United States, advances have been made with insects and plant pathogens, but these are largely unavailable to the general public at this time and are aimed at specific problems of alligatorweed and water hyacinths. Herbivorous fish may become an important tool in plant control, but the present widespread shipment and use of grass carp is being done without sufficient knowledge of possible adverse effects, and should be stopped until more information is obtained and shared with the public and the scientific community.

6.0 GENERAL PROGRAM POLICY

Among the sections of the Clean Water Act which establish Federal assistance programs, section 314 is one of the briefest and least detailed. In contrast to section 208, for example, where much of the content of the areawide planning studies is specified by Congress, 314 sets forth three goals, directs the Administrator to make financial assistance available to the States, and authorizes funding. Consequently, developing rules and regulations for the Clean Lakes Program involved many policy decisions. Since the regulations became effective, EPA has established additional policy guidance in the form of a 5-year strategy for operation of the Clean Lakes Program.

It is important that anyone involved with the program be aware of the program policies — both those implicit in the regulations and those stated explicitly in the regulations or elsewhere — for they affect allocation of available funds; review of applications; award of cooperative agreements; establishment of conditions on awards; monitoring and evaluation of results; and general program administration.

The purpose of this section is to review and explain Clean Lakes Program policy. The regulations, 40 CFR 35 Subpart H, will be cited but not quoted in the course of the discussion; they are reproduced in Appendix B. The policies are grouped in seven categories:

1. Eligibility.
2. Benefit maximization.
3. Long-term management vs. short-term improvement.
4. Integration and coordination with other programs.
5. Funding.
6. Monitoring and evaluation.
7. General program administration.

6.1 Policies on Eligibility for Assistance

6.1.1 Eligible Recipients

Section 314 restricts recipients of cooperative

agreement awards to States. To not preclude active participation by local government, a significant factor in the success of the Clean Lakes Program to date, the regulations permit (and EPA encourages) local government contributions toward the State's share of the costs. Moreover, through a substate agreement, a regional or local unit of government may perform some or all of the lake work under a cooperative agreement (40 CFR 35.1615).

6.1.2 Public Ownership and Access

A basic requirement for eligibility is that the lake be open and accessible to the public and that access be across publicly owned land (40 CFR 35.1605-3). Some flexibility is possible when the lake is in the public domain but all shoreline is privately owned. In such cases, the State must document long-term leases and easements which insure public access, and the access points must be marked with signs. The intent of this regulation is to insure that the benefits of a lake restoration or protection project are in fact enjoyed by the public, and not merely by owners of lakefront property. Public access must be provided independently of a Clean Lakes Project; Section 314 funds may not be used to purchase or lease property solely to provide access [40 CFR 35.1650-2(b)(7)].

6.1.3 Recreational Value

Included in the definition of "freshwater lake" (the only lakes eligible for section 314 assistance), is the requirement that the lake have recreational value (40 CFR 35.1605-2). This is consistent with the intent of Congress, as expressed in the overall goals of the Clean Water Act: "... water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water..." [Section 101(a)(2)]. Lakes which are used only for public water supply are ineligible for section 314 assistance (programs under the Safe Drinking Water Act assist drinking water supply projects; many water supply functions,

including reservoir maintenance, can often be paid for through water bills).

6.1.4 Requirement for State Classification Cooperative Agreements

Beginning January 1, 1982, States wishing to obtain EPA financial assistance for Phase 1 and Phase 2 projects must first have submitted to EPA a classification of their priority publicly owned lakes in need of protection or restoration and an explanation of the rationale for selecting the lakes surveyed (40 CFR 35.1620-6). The intent of this requirement is to improve the information base used to assess national need and to assign priorities to applications, so that section 314 funds can be requested and allocated on the soundest possible basis. To encourage completion of these classification surveys, EPA plans to make cooperative agreements available for them only until September 30, 1981.

6.2 Policies on Maximization of Public Benefits

Because program funds are limited, EPA awards cooperative agreements to maximize public benefits. This has several specific policy implications which are discussed in the next three sections.

6.2.1 Selection of Projects Near Population Centers

A recent study of projects funded under section 314 has shown that recreational benefits resulting from restoration and/or protection of lakes in or near urban areas, or in regions with large populations of seasonal residents or tourists tend to be significantly higher than those from projects conducted elsewhere (JACA Corp., 1980). Where larger numbers of people live or vacation within easy access to a lake, the number of users and thus the magnitude of public benefits is higher. The supply of high-quality lake recreational resources is often smaller, and the demand for them greater, in the metropolitan areas. In popular vacation areas, local and regional economies may directly depend on lake water quality. The Clean Lakes Program consequently gives preference to lakes in or near such areas in the competition for Federal funds. This policy should contribute to maximizing program benefits now, and increasingly so in the future, as higher energy costs and scarcity of fuel cause more Americans to take advantage of recreational opportunities nearer home. Fortunately, 99 percent of Americans live within a 50-mile radius of at least one publicly owned lake.

6.2.2 Pre-Award Assessment of Benefits

Only those proposals that completely articulate lake quality problems and proposed solutions will compete successfully for the available section 314 funds. The regulations require that

applicants describe the benefits being impaired because of degraded water quality, the extent of public access to the lake, and the public benefits which a pollution control and/or lake restoration project would generate [40 CFR 35 Subpart H Appendix A 1:(a)(3), (5), (7); (b)(2)]. In reviewing this portion of an application, EPA will be looking for convincing evidence that the lake project will yield benefits which are real and accessible, which are in short supply, and for which there is existing or potential demand by a large group of prospective users [40 CFR 35.1640-1(a)(4)]. Appendix E discusses methods of demonstrating prospective benefits.

6.2.3 Continuation of Benefits

EPA favors projects in which protective or restorative measures will continue after project conclusion to sustain public benefits over the long term. Therefore, EPA will be looking for Phase 2 Clean Lakes Projects which have a comprehensive maintenance program to ensure that pollution controls, once implemented, remain effective [40 CFR 35.1640-1(a)(9)]. Section 314 projects often yield dramatic and immediate results, but it is equally important to see that the benefits are of a lasting nature. Only through these activities can EPA hope to maintain or improve the current 8 to 1 public benefits to EPA cost ratio that has been demonstrated with Clean Lakes Projects (JACA Corp., 1980).

6.3 Long-Term Water Quality Management vs. Short-Term Improvement

Selecting projects that use protective or restorative techniques which will remain effective over the long term has always been an objective of the Clean Lakes Program. In-lake techniques, such as weed harvesting and dredging, while producing an immediate lake quality improvement, are rarely cost-effective by themselves in the long run. It is therefore EPA policy to give preference to applicants that propose protection and restoration techniques which control pollutants at their sources rather than control their symptoms in the lake. These techniques tend to be most effective on a watershed-wide basis. The application of agricultural and silvicultural best management practices that keep sediment and nutrients out of streams — no-till farming, manure collection, contour plowing, grassed waterways, and maintenance of vegetative cover, for example — offers great promise for keeping rural lakes healthy. For lakes in urbanized areas, septic system management ordinances, alternative wastewater treatment systems, and erosion and stormwater control techniques can all help stop the accumulation of pollutants.

The principal problems affecting the Nation's lakes are nutrient enrichment and inorganic sedimentation. These two polluting substances

must be addressed on a watershed basis; work in the watershed to control them must begin before or at the same time as in-lake restorative measures are undertaken if lake improvement is to be sustained. However, implementing source controls in the watershed may not always be sufficient to return a severely degraded lake to an acceptable condition in a reasonable amount of time. Some in-lake activity is then necessary. The section 314 regulations recognize this relationship by permitting the use of program funds for in-lake measures which are strictly palliative but restricting such awards to situations where pollution sources in the watershed have been controlled as completely as is practical [40 CFR 35.1650-2(b)(5)].

6.4 Integration and Coordination With Other Programs

A way to maximize water quality improvement nationwide is to coordinate Clean Lakes funds with other environmental quality management activities. The pollution problems in many lakes come from a variety of sources and might well be attacked by several Federal, State, and local programs. Ideally, the polluted lake can serve as the focus of all these efforts. While the Clean Lakes projects show immediate and measurable improvements in water quality and use, outputs and benefits can be many times greater if lake projects are coordinated with other related programs. Providing treatment for sewage from lakeshore homes under section 201, implementing agricultural pollution controls, or building or rehabilitating a lakeside park, are just a few opportunities to compound benefits of a Clean Lakes project. Such project cooperation can also reduce costs. Section 11.0 and Appendix H contain more detailed information on programs with good potential for coordination with Clean Lakes projects.

6.4.1 Restriction of Awards

One of the ways in which the Clean Lakes Program will effect this coordination is by limiting award of Federal lake funds to areas that are applying an integrated watershed management approach. Before making an award, the Regional Administrator must determine that any water pollution control measures in the lake's watershed authorized under section 201, included in an approved 208 plan, or required by section 402, have been completed or are proceeding on approved schedules [40 CFR 35.1650-2(b)(2)].

6.4.2 Promote Study of Coordinated Approach During Phase 1

Under the present Clean Lakes Program Strategy, funding preference will be given to applicants who propose to examine the coordinated approach as an alternative for implementing lake protection and restoration measures. In ad-

dition, EPA will continue to push for better integration of both in-house and other Federal programs through the mechanisms of Memoranda of Understanding (MOUs) and Interagency Agreements, formal acknowledgements among agencies of their intent to cooperate to achieve common goals.

6.4.3 Certifications of Consistency and Compliance

Another method to promote coordination is to insure that the proposed project is consistent with the State Water Quality Management work program and Comprehensive Outdoor Recreation Plan (if completed) and that it will use and not duplicate work completed under section 208. Consequently, States are required to include certifications of those relationships in Phase 1 and Phase 2 applications [40 CFR 1620-2(a), (b)(4), and (c)(2)].

6.5 Funding

6.5.1 Funding Levels

The 50 percent Phase 2 matching requirement could be reduced to 30 percent under section 314. However, section 314 funds are limited, and the 50-50 cost-sharing permits more projects to be funded. There is no evidence that a higher Federal share would elicit greater participation in the program. Furthermore, EPA has found that the 50 percent level necessitates a real State (and often local) commitment to the project which improves the chances of its successful implementation and continued maintenance.

6.5.2 Regional Allocations

Target amounts of Clean Lakes funds will be established annually for each EPA region on the basis of State forecasts. This is consistent with the decentralization of the application review and selection process to the regional offices. It facilitates negotiations with the States and puts the regional offices in a better position to forecast workloads and obtain necessary manpower and other resources. The targets will be based on State forecasts of Clean Lakes funding needs. However, competition for program funds is intense. If target amounts are not met in some Regions early each fiscal year, unobligated funds will be redistributed to Regions with more Clean Lakes activity. Because of this situation, it is important that States develop quality applications and submit them to the regional offices as soon as possible, preferably before the beginning of the fiscal years in which funding is desired.

6.5.3 State Priority Assignments

The assignment of State priority is a key step in the application procedure. Priorities are assigned annually in the work plan submitted to the Regional Administrator by each State [40 CFR 35.1620-5(a)(1)]. Realizing that reasons for

altering priorities may arise during the course of a year, EPA allows modification of the list whenever there is sufficient justification. For example, new data may indicate that a lower priority project will produce greater public benefits than originally thought, making it more attractive than one of higher priority from the standpoint of maximizing benefits. Also, matching funds may become available for a lower priority lake, through local contributions, before they can be obtained for one of higher priority.

6.6 Monitoring and Evaluation

It is EPA policy to maintain active monitoring and evaluation at project and program levels and in the area of research on lake protection and restoration technology.

6.6.1 Project Monitoring

Monitoring Phase 2 projects after completion is necessary to determine the effectiveness of Clean Lakes expenditures in improving water quality and providing public benefits. Post-project monitoring must continue for at least one year; the actual details and schedule of the monitoring program must be approved by the EPA project officer before other Phase 2 work begins [40 CFR 35.1650-3(c)(1)]. The program must include a reliable means of transmitting monitoring information to the Project Officer. Cooperative agreement recipients are required to report water quality data and administrative information for input to EPA's STORET (Storage and Retrieval) and GICS (Grants Information Control System) data management systems. Appendix G contains instruction and suggested formats for this purpose.

6.6.2 Monitoring at the Regional Level

Regional Clean Lakes coordinators, along with their State counterparts, are in the best position to assemble information on the progress and results of projects. From the application stage through project operation and maintenance (including watershed management activities), they should check each project with respect to the six other objectives described above, the section 314 regulations, and other environmental goals. Is program integration occurring? Are EPA priorities such as toxic pollution being addressed? Are all project alternatives being examined objectively? Are there any recurring problems, such as difficulty obtaining contractors for particular types of projects? Are the monitoring data being collected being put into STORET and GICS in the Regional Office, and are the data useful to the program? Are the project benefits being realized? Answers to these and other questions must be transmitted in two directions — to the State and EPA project officers for use in managing individual projects, and to Headquarters to be used in administering the national program. Workshops and conferences will be

scheduled to help accomplish this exchange of information.

6.6.3 Monitoring the National Program

Headquarters evaluates the program annually. Relying primarily on feedback from the Regions, midyear evaluations, 304(j) state-of-the-art reports, project evaluation reports, and analytical printouts from GICS and STORET, Headquarters staff monitors progress toward the overall goal established for the Clean Lakes Program. Progress toward specific program objectives are also assessed, and Headquarters may change an objective if it is not contributing to attaining the overall goal.

6.6.4 Evaluating Existing and Emerging Technology

The section 314 regulations also direct EPA to consider cost-effectiveness and energy-efficiency of in-lake alternatives in making funding decisions. The Clean Lakes Program currently relies on EPA's Office of Research and Development and lake restoration consultants to answer questions about the feasibility, efficiency and effectiveness of restoration techniques. As more research findings and demonstration project results are accumulated, decisions on cost-effectiveness and energy-efficiency can be made with greater certainty, and States will have more information to use in developing restoration and pollution control programs for their lakes.

As findings are generated, EPA will publish them through its technology transfer program and through additions to Sections 4.0 and 5.0 and Appendices C and D of this manual.

6.7 General Program Administration

It is only through a Federal, State, and local partnership that the objectives of the Clean Lakes Program can be achieved.

6.7.1 EPA Headquarters Role

In addition to overall program monitoring and evaluation described in subsection 6.6, EPA Headquarters is responsible for the following functions:

1. Developing model legislation and other guidance for use by Regions in helping States establish lake programs.
2. Developing guidelines for quality assurance and economic benefits assessment.
3. Obtaining appropriate fiscal year appropriations.
4. Developing national initiatives.
5. Developing national program guidance and policy.
6. Conducting technical reviews of applications for Regions.

7. Interacting with EPA Office of Research and Development in evaluating lake diagnostic, restorative, and protective technology.
8. Reporting annually on the Clean Lakes Program.
9. Tracking the status of grant information and obligation of program funds.

6.7.2 EPA Regional Office Role

The Regional Offices are the keys to maintaining the Federal-State partnership, because they perform most of the day-to-day administrative and technical assistance functions. In addition to the monitoring responsibilities described in subsection 6.6, the Regions:

1. Award and administer cooperative agreements.
2. Work with States in developing State programs, including preparing model legislation and regulations, priority lists, and annual work programs.
3. Assist States and local governments in preparing applications.

4. Conduct technical reviews and funding recommendations for all applications.

6.7.3 State Clean Lakes Programs

EPA strongly encourages States to establish their own Clean Lakes Programs. Most States are currently not in a financial position to match section 314 awards with State funds. However, States are aware of the effectiveness of Clean Lakes Projects and are eager to participate. Therefore, it is necessary that their ability to match section 314 funding be developed. Since support of this magnitude usually cannot be achieved on the local agency or general public level, State program legislation must be developed to implement and manage State Clean Lakes Programs consistent with section 314 of the Clean Water Act and EPA regulations. This includes preparing State work programs that include a priority ranking of lake restoration projects. The Regional Clean Lakes coordinators should work closely with their State counterparts in developing legislation, regulations, guidelines, strategies, and operating and management procedures.

7.0 LAKE CLASSIFICATION SURVEYS

7.1 Summary

On July 10, 1978, the EPA announced (in the *Federal Register*, Volume 43, No. 132, page 29617ff) the availability of financial assistance for performing statewide lake classification surveys. The announcement, reprinted in Appendix B, stated that EPA will provide financial assistance to States to:

1. Identify and classify publicly owned freshwater lakes according to trophic condition;
2. Establish a priority ranking for lakes determined to be in need of restoration or protection; and
3. Conduct feasibility studies to determine methods and procedures to protect or restore the quality of priority lakes.

Federal funding equal to 70 percent of the survey costs, but not exceeding \$100,000 per survey, must be matched by 30 percent non-Federal funds or in-kind services.

The EPA regulations covering cooperative agreements for lake restoration and protection require that States wishing to remain eligible for

section 314 financial assistance establish a procedure for determining the priority of freshwater publicly owned lakes for restoration, and classify those needing protection or restoration according to trophic level by January 1, 1982 (40 CFR 35.1630). State and EPA personnel will use this classification and priority ranking system to decide which lakes will receive funding for Phase 1 and Phase 2 programs.

7.2 Scope of Lake Classification Surveys

The scope of lake classification surveys varies from State to State, depending on the number and characteristics of the lakes, the existing lake data base, and the State's geographical location. For instance, some States have surveyed many of their lakes in the past and have a good lake data base. Consequently, these States may decide to perform in-depth diagnostic studies on one or more lakes which received a high priority for restoration. On the other hand, some States have a very poor lake data base and may decide to perform less detailed surveys of many lakes. The content of a typical classification survey is given in Table 7-1.

Table 7-1
*Information to be Supplied for Each Lake in a Typical State Classification Survey**

Official name.
Geographical location (including latitude and longitude of lake center).
Summary of available chemical and biological data demonstrating current water quality.
Indication of inclusion in EPA National Eutrophication Survey.
Indication of public ownership.
Description of impaired recreational values, and causes of impairment.
General physical characteristics of the lake.
Watershed description.
Major point source discharges.
Major nonpoint pollution sources.
Identification of cognizant 208 planning agency(ies).
Description of local interests in and resources committed to restoring the lake.
Indication of probable protection and restoration measures required.

7.3 Use of Lake Classification Survey Data

The classification and the priority ranking system developed by a State will be included in the annual work program which the State must submit to the EPA Regional Administrator each year. The work plan will list, in priority order, the cooperative agreement applications that will be submitted by the State for Phase 1 and 2 projects during the coming fiscal year. This information will assist EPA in allocating its financial resources to maximize public benefits derived from the Clean Lakes Program.

A prospective applicant for a Phase 1 or a Phase 2 project can use the lake classification survey data to learn the priority ranking of his particular lake, and determine the lake and watershed data available for it. This enables the applicant to estimate his chances of being funded in a particular fiscal year. If the priority is low, the applicant may be able to obtain additional data,

at its own cost, to convince the State and EPA to move it to a higher place on the priority list. If, on the other hand, additional data do not justify a higher ranking, the applicant may decide not to prepare an application, and thus avoid wasting time and resources.

Lake and watershed data in the classification survey can be invaluable to anyone preparing a Phase 1 application. The data may satisfy some of the information requirements on the Phase 1 application (described in Section 8.5 of this manual). In this case, knowing which required items are missing will assist the applicant in conducting whatever studies may be needed to complete the application. The data will also be useful in developing the Phase 1 work plan; they can be used to satisfy some Phase 1 requirements and to identify any additional background information that may be needed for the particular lake being studied.

8.0 PHASE 1 DIAGNOSTIC-FEASIBILITY STUDIES

8.1 Definition and Purpose

A diagnostic-feasibility study is a two-part study designed to determine a lake's current condition and to develop a proposed program for lake restoration and protection.

The diagnostic portion is a data gathering and analysis effort. It involves collecting sufficient limnological, morphological, demographic, and socioeconomic information about the lake and its watershed to answer four questions:

1. What is the present condition of the lake ecosystem?
2. How does, or will, this condition affect lake uses, and how important are these affected uses to the region?
3. What are the primary pollutants currently (or potentially) affecting the ecosystem?
4. What are the sources of these pollutants, and how much of each pollutant does each source contribute?

The feasibility portion of a Phase 1 study extends from the diagnostic work. Its purpose is to identify and evaluate possible techniques for restoring and/or protecting lake water quality to maximize public benefits; to provide sufficient technical, environmental, socioeconomic, and financial information to enable decision-makers to select the most cost-effective techniques; and to develop a technical plan for using the techniques selected. The principal questions to be answered in the feasibility study are:

1. What measures are available to restore or protect desired water quality in the lake?
2. Which alternative is the most cost-effective, taking into account not only anticipated water quality effects but also costs, public benefits, and any adverse environmental, social, or economic impacts?
3. What public benefits may be anticipated from the lake restoration or protection project?
4. How will the proposed project be implemented — technically, financially, and institutionally?
5. What provisions will be made to ensure that the benefits will be sustained after the project is completed?

A feasibility study must be accompanied by an environmental evaluation. The evaluation is not limited to the natural environment; it must consider potential impacts on people, housing, land use, agriculture, open space, and cultural resources, as well as energy, air quality, noise, lake ecology, floodplains, and wetlands.

Appendix A of 40 CFR 35 Subpart H (reproduced in Appendix B of this manual) states the specific requirements for the study, and Appendix E of this manual describes in detail how each requirement is to be met. The requirements are

Table 8-1
Phase 1 Diagnostic-Feasibility Study Outputs

A. Diagnostic Study	
1. Identification and location of lake	
2. Geological description of drainage basin	
3. Description of public access to lake	
4. Description of user population	
5. Summary of historical lake uses	
6. Explanation of any adverse impacts of lake degradation peculiar to segments of user population	
7. Discussion of alternative sites for lake users in region	
8. Inventory of point source discharges in watershed	
9. Description of land uses and related nonpoint source pollutant loadings in watershed	
10. Discussion and analysis of historical and current limnological data	
11. Lake's biological resources	
B. Feasibility Study	
1. Pollution control and restoration alternatives considered and selected	
2. Benefits expected to result from project	
3. Proposed Phase 2 monitoring program	
4. Proposed Phase 2 work schedule and budget	
5. Sources of Phase 2 matching funds	
6. Relationship to other programs	
7. Summary of public participation	
8. Plan for post-project operation and maintenance	
9. Required permits	
C. Environmental Evaluation	

summarized in Table 8-1. The remainder of this section concerns applying for, planning, and completing a Phase 1 study.

8.2 Types of Funding Assistance

Federal awards of up to 70 percent of study costs, with a maximum of \$100,000 per award, are available to support Phase 1 diagnostic-feasibility studies. A minimum of 30 percent of the total study costs must be provided from non-Federal sources, such as State, county, or local agencies. Non-Federal contributions may be cash or in-kind services. (Obviously, studies costing more than \$142,860 will require a non-Federal contribution of more than 30 percent because of the \$100,000 limit on Federal awards). Section 11.0 contains information on possible sources of matching funds and also describes programs which may provide money and services to augment the scope of Phase 1 studies.

8.3 Applying for Phase 1 Assistance

A State may apply to the EPA Regional Office for Phase I assistance, using Standard Form 424 (EPA Form 5700-33) which is in five parts:

1. Part I — Application.
2. Part II — Project Approval Information.
3. Part III — Budget Information.
4. Part IV — Program Narrative.
5. Part V — Assurances.

The application content is prescribed in 40 CFR 35.1620-2. In addition to the approvals contained in Part II, the State must certify that the project is consistent with the State Water Quality Manage-

ment work program and, if it has been completed, the State Comprehensive Outdoor Recreation Plan (SCORP). These certifications should be supplied as an attachment to Part II. States should also note that priority rating requested in Part II must be supplied. Otherwise, with the exception of Part IV, the form and its attached instructions are self-explanatory. Examples of completed applications accompany the case studies in Section 12.0.

Standard Form 424 does not contain rigid format requirements for the Part IV Program Narrative because its content should be specific to the program under which funds are being requested. For the Clean Lakes Program, Part IV is to contain a narrative statement of the procedures to be used in conducting the Phase I study. It also must include details and justification supporting the budget request in Part III. Certain easily-obtainable descriptive information on the lake and its watershed is required, and there are also a number of optional items, more difficult to obtain, which should be included to assist EPA in its review. All requirements for Part IV are described in the regulations; the outline in Table 8-2 is to be followed in completing a unified presentation.

It is important to keep in mind that an objective of the Clean Lakes Program is to maximize public benefits. Consequently, successful applications will be those with well-substantiated narrative statements which clearly demonstrate present or potential loss of public benefits caused by water quality problems, and which describe well-conceived programs for protecting or restoring benefits.

8.4 Application Review Criteria

A prospective applicant for Phase 1 funding assistance would be wise to become familiar with the criteria EPA uses in reviewing applications. They are specified in 40 CFR 35.1640-1 and summarized in Table 8-3. These criteria will be applied to each application received.

A prospective applicant should also be aware of EPA's 5-year strategy for the Clean Lakes Program. This strategy was developed to maximize the benefits from available limited funds. It includes policies which explain why certain types of projects may be more likely to be selected for funding than others. In general, selection is based not only on technical merit and other cri-

Table 8-2
Outline for Part IV Program Narrative

-
- A. Lake Description
 1. Legal name
 2. Location
 3. Physical characteristics
 - a. Morphometry
 - b. Hydrology
 - c. Stratification
 4. Physical, chemical, and biological data summary
 - a. Physical data — temperature, transparency, etc.
 - b. Chemical data — nutrients, pH, dissolved oxygen, etc.
 - c. Biological data — phytoplankton, macrophytes, invertebrates, fishes, waterfowl, and other wildlife
 - B. Watershed Description*
 1. Size
 2. Topography, geology, soils
 3. Land uses
 4. Population
 - C. Public Access, Benefits, and Recreational Use
 1. Type and amount of public access
 2. Present lake uses
 3. Impairment of recreational uses due to water quality
 4. Public benefits anticipated from pollution control or restoration
 - D. Pollutant Sources and Existing Control Practices*
 1. Point sources
 - a. Identification of discharges in watershed
 - b. Control measures (give NPDES number)
 - c. Estimated contribution to lake pollutant loading
 2. Nonpoint sources
 - a. Identification of major sources in watershed
 - b. Control measures implemented
 - E. Scope of Proposed Project
 1. Work plan development
 2. Study of lake and watershed characteristics
 3. Study of social, economic, and recreational characteristics
 4. Lake monitoring program
 5. Watershed monitoring program
 6. Data analysis
 7. Development and selection of alternatives
 8. Selection and development of watershed management and lake restoration program
 9. Projection of benefits
 10. Environmental evaluation
 11. Public participation
 - a. Program for public involvement
 - b. Local interest groups already committed to project
 12. Reports
 - F. Project Schedule
 1. Milestones, including key points for public involvement
 2. Bar chart
 - G. Project Budget
 1. Itemized cost estimate
 2. Justification of costs
 3. Non-Federal fiscal resources
-

* Optional information; include if available.

teria in Table 8-3 but also upon population density, socioeconomic conditions, and regional supply and demand for water-based recreation (see Section 8.0).

There is no specific deadline for submitting Phase 1 applications. However, funds are limited and competition for them is so intense that there is a backlog of applications at the end of each fiscal year awaiting funding in the following year. Consequently, Clean Lakes Program funds tend to be completely obligated earlier in the fiscal year than is the case in many other programs. Applications should be submitted as early as possible.

8.5 Conditions on Award

In addition to the general conditions which pertain to all EPA grants, Phase 1 cooperative agreements are subject to three conditions established in 40 CFR 35.1650-3.

First, when an award is made, the recipient must complete development of the physical, chemical, and biological data collection components of the work plan and receive project officer approval before beginning any other work under the grant.

Second, before selecting any pollution control or restoration alternatives, the recipient of Phase 1 assistance must submit an interim report to the project officer discussing all available alternatives and summarizing public participation and comment.

Third, when the techniques to be used have been selected, they must be approved by the project officer before any further work is accomplished under the agreement.

8.6 Conducting the Phase 1 Study

Although a Phase 1 study can be divided into two parts for discussion purposes, many aspects of the work are so interdependent that they should be integrated. This is because the diagnostic portion of the study provides site-specific data which is used in the feasibility portion. Fac-

tual information for the Phase I study consists of primary data collected in the field and laboratory and secondary data collected from libraries and Government agency files. Finally, after all the data have been gathered, they must be analyzed and the results integrated so that alternative restoration and protection approaches can be explored.

The study, as described in 40 CFR 35 Appendix A and detailed in Appendix E of this manual, can be accomplished by a program comprised of the following activities:

1. Development of a detailed work plan.
2. Study of the natural characteristics of the lake and watershed.
3. Study of social, economic, and recreational characteristics of the lake and watershed.
4. Lake monitoring.
5. Watershed monitoring.
6. Data analysis.
7. Development and evaluation of restoration alternatives.
8. Selection and further development of watershed management and lake restoration plan.
9. Projection of benefits.
10. Environmental evaluation.
11. Public participation.
12. Public hearing (when appropriate).
13. Reports.

EPA expects all Phase 1 studies to be completed within 3 years.

8.6.1 Detailed Work Plan

The purpose of the detailed work plan is to describe the work needed, and provide a schedule for its performance. The work plan should be of sufficient detail to enable the EPA Project Officer to understand the specific activities to be performed, follow the progress of the study, and make any necessary initial or mid-course modifi-

Table 8-3
Phase 1 Application Review Criteria

A. Technical Assessment of Proposed Study Approach to Meet EPA Requirements (See Appendix A of 40 CFR 35)
B. Estimated Lake and Watershed Improvements
1. Improvement in Lake Water Quality
2. Reduction in Pollutant Loadings
3. Improvement in Fish and Wildlife Habitat
4. Improvement in Sport and Commercial Fishery
C. Anticipated Benefits to the Public
1. Adequacy of Public Access to Lake
2. Extent of Public Benefit
D. Consistency with Clean Water Act
E. Reasonableness of Costs
F. Probability of Success
G. State Priority Ranking of Program
H. Means for Controlling Anticipated Adverse Environmental Impacts

cations. A typical work plan should identify and briefly describe each activity to be carried out. Relationships to and, especially, dependence upon other activities should be stated. Also, the specific outputs of the activity should be listed. The schedule can most easily be shown as a bar chart (Gantt chart) with start and finish dates for each activity, as illustrated by Figure 8-1.

Activity	1981												Start	Finish
	J	F	M	A	M	J	J	A	S	O	N	D		
A. Develop detailed work plan													1/1/81	1/31/81
B. Design lake monitoring program ..													1/1/81	2/28/81
C. Conduct lake monitoring													3/1/81	3/1/82
D. Collect regional socioeconomic data													3/15/81	4/30/81

Figure 8-1. Example of Phase 1 Schedule Format.

8.6.2 Study of Lake and Watershed Natural Characteristics

The study of lake and watershed characteristics can often be accomplished through collecting and analyzing secondary data — data already available from other sources including State Lake Classification Surveys, EPA's National Eutrophication Survey, 208 plans, U.S. Geological Survey and Soil Conservation Service maps, photographs, and publications, and State fisheries records. (Primary data, in contrast, are new data to be obtained directly from field and laboratory studies.) Typical secondary data needed to characterize the lake and watershed include:

1. Physical lake characteristics (area, volume, depth, mean flow, etc.).
2. Chemical and biological lake characteristics (dissolved oxygen, temperature, nutrients, chlorophyll *a* levels, phytoplankton, fish populations, etc.).
3. Watershed characteristics (drainage area, land use, topography, geology, and soils).
4. Pollutant sources (point sources, septic tanks, nonpoint sources, groundwater, etc.).

When secondary sources have been exhausted, the resulting body of data should be compared with the requirements described in Appendices B (regulations) and E (Phase 1 study protocol, which also contains more details on data sources and collection methods). Any deficiencies in the required data will have to be remedied by collecting primary data.

8.6.3 Study of Lake and Watershed Social, Economic, and Recreational Characteristics

Most of the social, economic, and recreational information is likely to be available from secondary sources. It includes:

1. Historical lake uses;
2. Previously identified problems (fish kills, taste and odors, water-borne illnesses, loss of recreation potential, etc.);
3. Socioeconomic structure of the community, and how the lake relates to it;
4. Public access and recreational uses.

Appendix E of this manual provides more details on requirements and sources.

Evaluation of the secondary data, described in 8.6.2 and this subsection, provides the basis for designing the primary data collection activities and analyzing the results. It also provides guidance in locating the lake and watershed monitoring sites. For example, existing land use data show major land uses in the watershed. Knowing these land uses provides a rationale for monitoring specific tributaries and other critical areas in the watershed. Because Phase 1 studies have a limited level of funding (e.g., \$100,000 of Federal funds), the selection of representative sampling sites is critical.

8.6.4 Lake Monitoring

Primary data will be collected by monitoring the lake and watershed. In general, lake monitoring is performed to define the trophic state of the lake and to characterize its hydrological and ecological dynamics. This is accomplished by measuring physical, chemical, and biological parameters in the lake (e.g., nutrients, chlorophyll *a*, phytoplankton, dissolved oxygen-temperature profiles). Section 10.0 is devoted entirely to the subject of monitoring. Appendix E contains additional details on how the monitoring requirements of 40 CFR 35 are to be met.

8.6.5 Watershed Monitoring

Watershed monitoring is performed for many reasons. One example is determining annual nutrient and hydrological budgets for a lake. Monitoring can also be used to determine the nutrient or sediment contribution from different land uses, groundwater, septic tanks and other sources, if information more precise than that obtainable using land use data and loading coefficients is necessary. To calculate the annual watershed contribution of a specific substance, both dry and wet weather monitoring of tributaries and land areas are required. Concentrations in monitoring wells, in areas around septic tanks, and from point sources are also necessary. Section 10.0 and Appendix E should be consulted for more details.

8.6.6 Data Analysis

Primary and secondary data are analyzed to provide the basis for the feasibility portion of the Phase 1 study. Types and methods of analyses vary depending on the nature of the lake and its problems. In every case, however, the overall process involves:

1. Demonstrating the relationships among present or potential water quality problems and impaired lake uses.
2. Determining the causes of water quality problems.
3. Quantifying the contributions of pollutant sources to water quality degradation.

Typical analyses which will have to be performed in nearly every case are hydrologic budget, limiting nutrient identification, budget of significant pollutants, development of pollutant loading water quality relationships, and determination of loading reductions necessary to achieve water quality objectives.

Section 10.0 provides guidance on analysis of lake and watershed monitoring data. Appendix E contains additional information on the analysis of all types of data collected during the diagnostic portion of a Phase 1 study.

8.6.7 Development and Evaluation of Alternatives

The feasibility study involves developing alternative management programs based on the results of the diagnostic study. Alternatives can include best management practices, lake restoration methods, or both.

The process begins with three questions:

1. Where, in the watershed or lake, can present or potential sources of problem pollutants be controlled to the extent determined to be necessary in the diagnostic portion of the study?
2. What alternatives are available to control them?
3. What additional in-lake conditions will have to be corrected to restore the lake, and what alternatives are available to accomplish restoration?

Once a preliminary list of alternatives has been compiled, each can be evaluated in terms of cost, reliability, technical feasibility, energy consumption, and social, economic, and environmental impact. Appendix F provides guidelines for this cost-effectiveness analysis. Alternatives for watershed management and in-lake restoration are reviewed in Sections 4.0 and 5.0, respectively.

In evaluating the cost-effectiveness of an alternative, one should be careful to do it in the context of the project and not in the abstract. For example, street sweeping and catch basin cleaning may be easier and less expensive than certain agricultural best management practices. Howev-

er, if a 30 percent reduction in total phosphorus loading to the lake in question is required and the phosphorus budget shows that 60 percent of the input to the lake is from agricultural sources and 40 percent from urban runoff, it is likely that agricultural controls will be more effective. Moreover, achieving a 50 percent reduction in agricultural phosphorus loading will probably be more cost-effective than trying to obtain a 75 percent reduction in urban phosphorus sources.

8.6.8 Selection of a Watershed Management and Lake Restoration Program

The evaluation of available alternatives should be presented in a format which will be easily usable by those who must make the final selection and by the public, which must be given an opportunity to provide comments at this stage. Appendix F contains suggestions for this presentation.

When the selection has been made, the program must be described in detail. Where applicable, preliminary engineering drawings should illustrate the construction aspects of the project. For generalized (rather than site-specific) watershed management practices, priority ranking and scheduling of controls for specific sub-basins or land uses should be described instead of detailed design and implementation data. The institutional approaches and strategy that will be used to implement the management program should be emphasized. A description of applicable best management practices (BMP's), however, should be categorized according to land uses within the watershed. Where possible, the controls should also be keyed to specific sub-basins or land characteristics (such as slope, soil type, groundwater level). For all aspects of the program, a quantitative estimate of the pollution control effectiveness and anticipated lake water quality improvement should be provided.

Once the EPA project officer has approved the selection, work can proceed on developing other details of the program which are required outputs of Phase 1:

1. Phase 2 monitoring program.
2. Phase 2 schedule and budget.
3. Sources of non-Federal funds for Phase 2.
4. Relationship of Phase 2 plans to other programs.
5. Operation and maintenance plan.
6. Required permits.

These items are discussed in detail in Appendix E.

8.6.9 Projection of Benefits

A key factor in the decision to award Phase 2 funds will be the public benefits anticipated from the project. Projected benefits should be developed during the feasibility portion of the Phase 1 study.

A convincing demonstration of benefits is one which shows:

1. The relationship between anticipated water quality impacts and lake uses.
2. The existence of demand for the new, improved, or protected uses.
3. The adequacy of public access to those uses.
4. The absence of excess capacity at alternative sites in the region which offer similar uses.

The demonstration should conclude with a quantitative projection of benefits, compared to baseline usage. (Note that if the project is designed to protect existing uses, projecting benefits involves comparing the existing lake usage with a projected decline in usage in the absence of the project.) Appendix E contains additional guidance on benefits projection.

8.6.10 Environmental Evaluation

An environmental evaluation of the proposed pollution control or restoration program is required in a Phase 1 study. Much of it will have already been completed during the evaluation of alternatives, since socioeconomic and environmental impacts are part of the cost-effectiveness analysis. What remains to be done is to document those impacts for the selected program and to develop and describe mitigative measures for adverse impacts. Table 8-4 can be used as a checklist to ensure that the 14 specific topics which must be addressed in a evaluation are properly covered. Appendix E discusses each topic in detail.

Although the required content of the evaluation is presented in simple question form, the applicant should provide a narrative statement explaining his "yes" or "no" answer to the questions, at least for those questions applicable to the proposed project. Where the question is obviously not applicable to the proposed project, the applicant may provide a simple "no" (meaning no adverse impact) answer. Whenever a "yes" (meaning there will be an adverse impact) answer is given, the applicant should explain the nature and extent of the proposed adverse impact, how it can be mitigated or avoided, and if it is possible to do so.

8.6.11 Public Participation

Clean Lakes projects are subject to the requirements of 40 CFR 25, "Public Participation in Programs Under the Resource Conservation and Recovery Act, the Safe Drinking Water Act and the Clean Water Act." These regulations state EPA's objectives for public participation:

1. To assure that the public has the opportunity to understand official programs and proposed actions, and that the Government fully considers the public's concerns;
2. To assure that the Government does not make any significant decision on any activity covered by this part without consulting interested and affected segments of the public;
3. To assure that government action is as responsive as possible to public concerns;
4. To encourage public involvement in implementing environmental laws;

Table 8-4
Required Content of Environmental Evaluation

Will the project displace people?
Will the project deface existing residences or residential areas?
Will the project be likely to lead to changes in established land use pattern or an increase in development pressure?
Will the project adversely affect prime agricultural land or activities?
Will the project adversely affect parkland, public land or scenic land?
Will the project adversely affect lands or structures of historic, architectural, archaeological or cultural value?
Will the project lead to a significant long-range increase in energy demands?
Will the project adversely affect short-term or long-term ambient air quality?
Will the project adversely affect short-term or long-term noise levels?
If the project involves the use of in-lake chemical treatment, will it cause any short-term or long-term adverse effects?
Will the project be located in a floodplain?
Will structures be constructed in the floodplain?
If the project involves physically modifying the lake shore, its bed, or its watershed, will the project cause any short- or long-term adverse effects?
Will the project have a significant adverse effect on fish and wildlife, wetlands or other wildlife habitat?
Will the project adversely affect endangered species?
Have all feasible alternatives to the project been considered in terms of environmental impacts, resource commitment, public interest, and cost?
Are there other measures not previously discussed which are necessary to mitigate adverse impacts resulting from the project? Describe.

5. To keep the public informed about significant issues and proposed project or program changes as they arise;
6. To foster a spirit of openness and mutual trust among EPA, States, substate agencies, and the public; and
7. To use all feasible means to create opportunities for public participation.

The regulations also spell out the general responsibilities for public participation which must be met by EPA, State, interstate, and substate agencies.

The regulations which govern the Clean Lakes Program highlight three areas of Phase 1 studies in which public involvement is required (40 CFR 35.1620-4):

1. In developing, evaluating, and selecting alternatives;
2. In assessing potential adverse environmental impacts; and
3. In identifying measures to mitigate any adverse impacts that were identified.

Fact sheets or summaries are to be distributed at least 30 days before selecting a proposed restoration method, and a public meeting is to be

held before the selection is made. An advisory group is not required but should be formed if public interest warrants. A formal public hearing is not generally required during a Phase 1 study, unless dredging or some other activity involving significant modification of the environment is being recommended as the restoration method. The need for a hearing will be determined by the EPA project officer.

The critical aspects of effective public participation are to establish the groundwork for it early, to integrate it into the project, and to demonstrate responsiveness to the inputs it provides. Appendix E provides guidance on establishing and conducting effective public participation under a Clean Lakes Cooperative Agreement.

A summary of public participation is a requirement of the Phase 1 output. Appendix E describes its content.

8.6.12 Reports

Required Phase 1 reports in addition to the public participants summary are:

1. Semi-annual progress and expenditure reports.
2. Financial status reports.

9.0 PHASE 2 IMPLEMENTATION PROGRAMS

9.1 Purpose and Definition

The purpose of a Phase 2 cooperative agreement is to implement recommended methods for controlling nonpoint source pollutants from entering a lake, to implement in-lake methods to improve lake quality, or to implement a combination of pollution and in-lake restoration measures.

Control of nonpoint source pollutants can be achieved by implementing specific elements of a watershed management program. A watershed management program, as described in Section 4.0, identifies the sources and levels of pollutants, indicates required reductions in these pollutants, and presents a set of control practices for obtaining these reductions. (The final product of a Phase 1 diagnostic-feasibility study should be a watershed and lake restoration management program providing control and restoration activities for the lake and its watershed.)

The watershed management program for a given lake may include:

1. Nonpoint source controls, or best management practices (BMPs), for various land uses and activities.
2. Control of storm sewer discharges.
3. Reduction in wasteloads from industrial and municipal point sources.

Phase 2 cooperative agreements support BMPs to control pollution from stormwater runoff and other nonpoint sources. They may not be used to control industrial or municipal point sources, since there are other active State and Federal programs for this purpose.

If restoration of, or pollution control for, a given lake necessitates reduction of point source loadings, this can be accomplished by:

1. Enforcement action by the State or EPA against municipal or industrial dischargers which are not complying with their NPDES permits;

2. Establishment of more stringent permit requirements by the State through development of wasteload allocations. In this case, dischargers may be in compliance with their present permits, but a further reduction in point source loadings has been shown to be a cost-effective method of lake restoration or protection.

Federal assistance under the 201 Construction Grants Program is available to municipal sewage treatment plants to upgrade treatment. Pollution control financing at reduced interest rates, industrial development bonds, and Small Business Administration loans may be used by industrial dischargers.

Watershed management measures that can be funded by a Phase 2 cooperative agreement include specific best management practices, such as sedimentation basins, grassed waterways, street sweeping and other practices described in Section 4.0 and Appendix C. Other watershed management practices funded by Phase 2 agreements include ordinances and environmental education programs.

Specific in-lake restoration techniques can also be funded through a Phase 2 cooperative agreement. The applicant, however, must show that the causes of the deteriorated lake conditions have been or are being eliminated or reduced to the greatest extent practicable. The purpose of Phase 2 is long-term protection and restoration of publicly-owned lakes; in-lake measures to alleviate symptoms without considering the upstream or shoreline causes of the problems will not be supported.

Various lake restoration methods that can be funded by Phase 2 programs are described and evaluated in Section 5.0 and Appendix D. The lake restoration methodologies presented in this manual are not all-inclusive; they reflect the present state-of-the-art in lake restoration. Other methodologies can be used if the applicant can show that they may be effective. Periodic lake

treatments, such as applying copper sulfate for algal control, are not eligible for funding under Phase 2 programs since they merely treat the problem rather than its cause.

Many lakes may require the implementation of both watershed management practices and in-lake restoration measures. The specific requirements will vary depending on the size and characteristics of each lake and its watershed, the nature and severity of the problem, socioeconomic conditions, climate, and institutional structure. For instance, in a small urban lake, a relatively small watershed management program consisting of street sweeping and storm sewer relocation may be sufficient to reduce pollutant loadings to acceptable levels. However, a large in-lake effort, such as dredging of the entire lake, may be necessary to restore desired lake uses impaired by the accumulation of pollutants from previous years.

On the other hand, a large lake with a large watershed may require a large and comprehensive watershed management program comprised of nonpoint source controls for cropland,

pasture, residential development and roadways. The management plan may also include the development of land use and erosion control ordinances, and educational programs. However, it may require only a relatively small in-lake restoration effort, such as aeration of a small bay or dredging of several lake inlets.

A hypothetical Phase 2 case study is presented in Section 12.0. The regulations which pertain to Phase 2 cooperative agreements are in 40 CFR 35 Subpart H, reproduced in Appendix B to this manual.

9.2 Types of Assistance

Phase 2 implementation program awards are made on a 50/50 funding basis (i.e., requiring a 50 percent non-Federal share). Unlike the Phase 1 awards which have an upper limit of \$100,000 in Federal funds per project, Phase 2 awards do not have an upper limit.

The availability of non-Federal matching funds may be a practical constraint in some cases. The 50 percent State or local share, however, may

Table 9-1
Required Contents of Phase 2 Application

-
- | | |
|----|--|
| A. | State Priority Ranking |
| | 1. State Classification of Lake |
| | 2. State Priority Ranking of Lake |
| B. | State Certifications |
| | 1. State Water Quality Management Work Plan Compliance |
| | 2. 208 Water Quality Management Plan Consistency |
| | 3. Comprehensive Outdoor Recreation Plan Compliance |
| C. | Diagnostic Information On Lake and Watershed |
| | 1. Physical Characteristics of Lake |
| | 2. Chemical Characteristics of Lake |
| | 3. Biological Characteristics and Resources of Lake |
| | 4. Watershed Characteristics |
| | 5. Public Access and Recreational Use |
| | 6. Pollutant and Hydrologic Budgets |
| | 7. Point Source Inventory |
| | 8. Nonpoint Source Inventory |
| | 9. Trophic Classification of Lake |
| | 10. Pollutant Reduction Requirements |
| D. | Feasibility Information |
| | 1. Summary of Available Pollution Control and Lake Restoration Alternatives |
| | 2. Description of Proposed Program |
| | 3. Proposed Program Benefits |
| | 4. Phase 2 Implementation Schedule |
| | 5. Phase 2 Budget |
| | 6. Description of Non-Federal Funding Sources |
| | 7. Relationship of the Proposed Project to Other Pollution Control Programs. |
| | 8. Public Participation Program |
| | 9. Post-Project Operation and Maintenance Plan |
| | 10. Phase 2 Monitoring Program |
| | 11. Phase 2 Evaluation Plan |
| E. | Environmental Impact Evaluation |
| | 1. Environmental Impact Evaluation Checklist (Table 8-4) |
| | 2. Narrative Statements for Adverse Impacts and Mitigative Measures |
| F. | Applicable Permits or Permit Applications |
| | 1. Section 404 Corps of Engineers Dredging Permit |
| | 2. State Permits |
-

consist of cash, equipment, materials, in-kind services, rental values and depreciation.

9.3 Contents of Application

As in the case of Phase 1 applications, Phase 2 funding requests are to be made to the EPA Regional Office on Standard Form 424 (EPA Form 5700-33). All applications must contain the information and certifications listed in Table 9-1.

If an applicant has completed a Phase 1 diagnostic-feasibility project, the final report of the Phase 1 project should be included as the Part IV Program Narrative in the Phase 2 application. If an applicant has not performed a Phase 1 project, the Phase 2 application must include essentially the same information required from a Phase 1 diagnostic-feasibility study (see Section 8.0), presented in the same order as in Table 9-1. Such a study defines the lake water quality problems, identifies their causes, and recommends measures for pollution control and lake restoration. Both the State and EPA need this information to evaluate the proposed Phase 2 program, and to develop a priority ranking relative to other Phase 2 applications on a State, regional and national basis. (Specific program review criteria are presented in Section 9.4.)

If all the information required in Appendix A of 40 CFR 35 is not available, the applicant can obtain this information at his own expense by performing a lake and/or watershed study, or obtain the information with Federal cost-sharing (at 70 percent) by performing a Phase 1 diagnostic-feasibility study. Section 8.0 and Appendix E to this manual explain Phase 1 information requirements. If all but a few required items are available, an applicant may be permitted to obtain the missing information in the initial stage of the Phase 2 project.

A sample Phase 2 application appears in Section 12.0.

9.4 Review Criteria

Application review and evaluation will be performed as described in 40 CFR 35.1640 (see Appendix B) and summarized in Table 9-2. These review criteria will be applied to each application as it is received. There is no specific deadline for submitting Phase 2 applications; however, applications received early in the fiscal year may have a higher probability of being funded. Competition for Clean Lakes Program funds is so intense that there is a backlog of applications at the end of each fiscal year awaiting funding during the next one. Consequently, funds tend to be completely obligated in this program earlier in the year than in many other programs. Applications should be submitted as early as possible.

In addition to the criteria in Table 9-2, EPA will examine each application from the standpoint of the policies embodied in the 5-year strategy for

the Clean Lakes Program. These are discussed in Section 6.0.

9.5 Limitations on Awards

Before approving an application the EPA Regional Administrator must ensure that the limitations presented in 40 CFR 35-1650-2 (see Appendix B of this manual) are met. The Regional Administrator must determine that:

1. All application requirements are met;
2. The State/EPA Agreement (SEA) or Water Quality Management Work Program includes the section 314 Clean Lakes Program;
3. The Phase 1 project report (if a Phase 1 project was performed) was used in the Phase 2 application, and the program proposed for implementation is the one selected under Phase 1;
4. Pollution control measures authorized by a 201 Facilities Plan or 208 Wastewater Management Plan or required in 402 NPDES permits are complete or are being implemented in the watershed;
5. The project does not include control of point sources which can be handled under Sections 201 or 402;
6. Open space policies required by the Clean Water Act have been considered;
7. The project does not include ineligible costs as described in 40 CFR 35.1650-2.

9.6 Conditions on Awards

In addition to EPA's general grant conditions, Phase 2 cooperative agreements are awarded

Table 9-2
Phase 2 Application Review Criteria

A. Technical Feasibility of Program
B. Estimated Lake and Watershed Improvements
1. Improvement in Lake Water Quality
2. Reduction in Pollutant Loadings
3. Improvement in Fish and Wildlife Habitat
4. Improvement in Sport and Commercial Fishery
C. Anticipated Benefits to the Public
1. Adequacy of Public Access to Lake
2. Size and Economic Structure of Lake User Population
3. Availability of Public Transportation to Lake
4. Availability of Other Lakes within 50 Mile Radius
5. Extent of Public Benefit
D. Financial Feasibility
1. Reasonableness of Proposed Costs
2. Probability of Program Success
3. Benefit/Cost Analysis
E. State Priority Ranking of Program
F. Anticipated Adverse Environmental Impacts
G. Proposed Operation and Maintenance Program
H. Compliance with 201 and 208 Open Space Policies

subject to the following conditions (40 CFR 35.1650-3)

1. The State must monitor the project to provide adequate data on effectiveness;
2. All pollution control measures implemented under the agreement must be maintained at least at the same level of efficiency throughout the project as they were at the time of implementation;
3. State water quality standards shall be upgraded if higher quality uses are achieved because of the project;
4. Any equipment purchased shall be properly maintained for at least its depreciable life and shall remain a part of the project;
5. The State must carry out mitigation measures for any primary adverse environmental impacts which occur;
6. Work shall be stopped or modified as necessary to protect any unrecorded archaeological sites discovered;
7. Necessary permits must be received before any disposal of dredged or fill material is initiated.

9.7 Monitoring Requirements

Each Phase 2 cooperative agreement requires that a limited monitoring program be performed throughout the project and for at least one year after restoration or after pollution control devices have been placed in operation. The purposes of the monitoring are: to provide sufficient data to redirect the project if necessary, to ensure that project objectives are achieved, and to evaluate the effectiveness of the methods being implemented. The Phase 2 monitoring program should be designed, whenever possible, to measure conditions prior to, during, and after project implementation.

Specific monitoring guidelines are presented in Appendix A of 40 CFR 35 Subpart H (see Appendix B of this manual). These guidelines are expanded and discussed in Section 10.0 and Appendix E. They should be used as a guide in designing a Phase 2 monitoring program, not as an absolute requirement. Each Phase 2 monitoring program will be designed based on the site-specific characteristics of the lake and its watershed. It should also be based on the specific lake restoration or watershed management activities being performed. EPA project officer approval is required.

9.8 Watershed Management and Lake Restoration Methodologies

A description and brief evaluation of watershed management practices and lake restoration methodologies are presented in Sections 4.0 and 5.0, respectively. More detailed information on specific best management practices and lake

restoration methodologies is presented in Appendices C and D, respectively.

The management practices and restoration methodologies presented in this manual are intended to provide an overview of the state-of-the-art practices; they are not intended to be all-inclusive. Other feasible management and restoration practices may be available and may be applied in a Phase 2 program.

Since it is not possible to provide in-depth descriptions and evaluations of management and restoration practices in this manual, the applicant is encouraged to seek additional information in the many references provided.

9.9 Cost Evaluation

Application review criteria contained in the Clean Lakes Program Regulations include an evaluation of the reasonableness of the proposed Phase 2 costs relative to the proposed Phase 2 activities. This evaluation must consider the likelihood that the project will succeed and produce public benefits.

Prior to submitting a formal Phase 2 application, the applicant should perform a cost evaluation of the proposed project to determine whether the proposed costs justify the potential benefits. Appendix E contains useful information for this analysis.

9.10 Environmental Evaluation

As part of the application, Phase 2 applicants must submit an evaluation of the environmental impacts of the proposed project. This requirement is normally fulfilled as a part of a Phase 1 study. However, there are situations where the necessary diagnostic and feasibility information was obtained in some way other than under a Phase 1 cooperative agreement. In such cases, the applicant should meet the environmental evaluation requirements described in Subsection 8.6.10 and Table 8-4 in the Phase 2 application.

All Phase 2 applications must describe alternatives considered for the project. Each alternative should be described in terms of its environmental impacts, the resources that would have to be committed, the public response to the alternative (obtained through the public participation process), its cost, and the reasons for rejecting the alternative.

9.11 Public Participation

The applicant must encourage public participation in the evaluation of alternative watershed management and lake restoration programs as required under 40 CFR 1620-4. The Phase 2 application must describe the public participation activities related to the proposed project. The application must also summarize the applicant's response to all public comments received. All written comments received by the applicants,

concerning the project, must be included in the Phase 2 application.

Since Phase 1 studies require formal public participation activities, including at least one public meeting, a summary of the Phase 1 public participation program (including public comments and applicant's responses) will be sufficient to meet the Phase 2 application public participation requirements. Where a Phase 1 study has not been performed, the applicant must provide an opportunity for public review of the proposed project [40 CFR 1620-4(c)(2)]. Moreover, when major construction, dredging, or other significant activities are proposed, or when EPA determines it to be necessary for other reasons, the applicant must hold a public hearing to discuss the proposed project.

In summary, the goals of public participation activities should be: to make the public aware of the proposed project, obtain and respond to public comments on the project, and document all public participation activities so that they can be used in the Phase 2 application.

9.12 Project Schedule

In general, Phase 2 projects should not exceed 4 years unless the EPA Regional Administrator approves a longer period. The 4 year period should include pre-project monitoring, project implementation, post-project monitoring, project evaluation, and final report preparations.

9.13 Awards

The EPA will notify the applicant, usually within 90 days after receiving an application, that the project is approved, disapproved, or returned due to lack of available funds. Disapproved applications may be resubmitted as new applications if the State or local applicant resolves the issues identified by the EPA.

9.14 Report Requirements

Report requirements for Phase 2 projects are presented in 40 CFR 35.1650-6 (see Appendix B of this manual). Progress reports (due quarterly or less frequently depending upon the complexity of the project), financial status reports, and a final report are required.

10.0 LAKE AND WATERSHED MONITORING AND DATA ANALYSIS

10.1 Introduction

General information on monitoring requirements of the Clean Lakes Program are presented in paragraphs (a)(10) and (b)(3) of Appendix A to 40 CFR Part 35 Subpart H (see Appendix B to this manual). However, to be effective, it is important that a specific monitoring program be designed for each Clean Lakes project. The regulations should be considered as guidelines for designing an effective monitoring program; they may be modified or supplemented to meet project-specific needs, with EPA project officer approval.

Monitoring programs designed for Phase 1 and Phase 2 projects will be different because the objectives are different. A Phase 1 monitoring program should be designed to facilitate diagnosis of the lake's problems and evaluation of alternative protection and restoration procedures. Monitoring data will thus be used to identify the lake's trophic condition, identify problem pollutants and quantify their sources, and develop a management program for the lake and watershed. A Phase 2 monitoring program, on the other hand, should be designed to assist in evaluating the effectiveness of lake protection and restoration procedures and the benefits produced by the project.

The purpose of this section is to explain Clean Lakes Program monitoring requirements and to present guidelines for monitoring program design and data management and interpretation. Much of the discussion will be in the context of a Phase 1 study, since monitoring is usually more extensive than in Phase 2, and the monitoring requirements for Phase 2 vary widely with the types of restoration activities being implemented. However, the general principles covered are applicable to both Phase 1 and Phase 2. Appendix E, a protocol for the conduct of Phase 1 studies, contains step-by-step instructions on collecting the data required for Phase 1 in the regulations.

A forthcoming publication in EPA's Ecological

Research Series (Reckhow, in press) covers the subjects of sampling design for in-lake monitoring and nutrient budget development, data analysis and presentation, lake water quality indices, and lake trophic state monitoring in considerably more detail than is possible in either this section or Appendix E. Investigators should obtain a copy of it for use in preparing and executing those aspects of their project work plans.

10.2 Lake Monitoring

Lake monitoring includes the measurement of basic physical and chemical parameters, such as surface area, volume, inflow and outflow, transparency, nitrogen and phosphorus, suspended solids, pH, and alkalinity. These parameters describe the environment that influences the trophic condition of a lake. Inflow and outflow are used to determine residence time, which, in combination with volume and surface area, is a principal determinant of the lake's capacity to assimilate nutrients and other materials transported from the watershed. Nitrogen and phosphorus are major plant nutrients. Suspended solids provide an indication of the extent of soil transport from the watershed. Alkalinity and hydrogen ion concentration (pH) not only determine how other chemicals behave in or affect the lake, but, to a great extent, what plants and animals can live in it.

Vertical temperature and dissolved oxygen profiles are also measured; they provide important information on thermal stratification and mixing and on the occurrence and extent of oxygen deficits, and thus the quality of the lake as habitat for fish and other aquatic organisms.

Biological lake parameters include chlorophyll *a*, algal cell counts and genera, macrophytes, and bacteria. Chlorophyll *a*, a green pigment produced by all algae, serves as a simple yet effective standardized measure of algal biomass. Algal cell count provides another measure of the

algal population, and with identification to genus, gives an indication of the algal diversity. For instance, healthy lakes usually have a high algal diversity, that is, many genera of algae present at one time; eutrophic lakes, however, usually are dominated by one or a few algae during the period of elevated biological activity. In fact, many eutrophic lakes are dominated by blue-green algae during the late summer and early fall. Macrophyte analyses, usually performed by visual observation or photography of the lake, show the extent and variety of rooted aquatic plants. The composition and relative magnitude of the algae and macrophyte populations in a lake are two indicators of its trophic condition.

Bacterial analyses in a lake can include fecal coliform, total coliform, and fecal streptococcus. All of these bacteria are indicator organisms; most are harmless, but their presence indicates the possible presence of pathogenic (disease producing) bacteria. The ratio of fecal coliform to fecal streptococcus can be used to indicate whether the observed bacteria levels are caused by human activities (wastewater discharges, septic tanks) or stormwater runoff (animal wastes).

10.2.1 Lake Monitoring Program Design

In designing a lake monitoring program, consideration should be given to the type of project and proposed activities, the available technical and financial resources, the lake and watershed characteristics, and the data requirements and data collection techniques (described in Appendix E).

In general, a Phase 1 study will require a larger, more detailed lake monitoring program than a typical Phase 2 project. This is because a Phase 1 monitoring program is usually performed to answer many questions — existing trophic state, identity, magnitude and sources of pollutants, potential response to pollutant reductions — whereas a typical Phase 2 monitoring program is usually performed to answer only one — the response of the lake to watershed management or in-lake restoration activities.

In addition, the activities being carried out in the project influence the monitoring program. For example, if dredging is contemplated, sediments must be analyzed. Where chemical application is a recommended restoration measure, pilot tests and bioassays are necessary to determine dosage rates which are both effective and ecologically acceptable.

The project applicant should avoid the pitfall of over-designing the lake (or watershed) monitoring program at the expense of other equally important project tasks. Too often a disproportionate amount of a project's resources is budgeted for field monitoring and laboratory analysis, and an insufficient amount is budgeted

for project administration, quality assurance, data interpretation, and management plan development. The best data are useless if resources are not available to properly analyze and interpret them and apply the results.

The final considerations in designing a lake monitoring program are the lake and watershed characteristics. The number of lake stations, the depths sampled, and the parameters measured all depend on them. Additional sampling sites may be needed where the physical characteristics of the lake (shape, depth, location of tributaries, flow patterns, etc.) create hydrologic or limnologic sub-basins. Basically, this means that additional sites should be monitored if one site is insufficient to adequately characterize the physical, chemical, and biological conditions of a lake. Differences in lake sites can be caused by lake shape and depth, the influence of tributaries, point and nonpoint discharges, in-lake currents, wind currents, and many other factors. When uncertain as to the number of sites needed, existing lake data from several sites and sampling dates may be statistically analyzed. If these data do not exist, then new data from multiple sites and dates must be collected for analysis. If statistically significant differences do not exist among several sites, the EPA Project Officer should be contacted for approval of a reduction in the number being sampled. (See Appendix E for several examples of lakes requiring multiple lake monitoring sites.) It is important, however, to recognize that monitoring design is fundamentally a statistical problem. Reckhow (1980) and Chapra and Reckhow (1981) provide statistical guidance and examples that address this topic.

If a lake is subject to significant public contact or is fished for consumptive purposes, consideration should be given to including both standard bacteriological analyses (total and fecal coliform, fecal streptococcus) and fish flesh analyses for heavy metal and organic contamination. Fish flesh analyses are usually expensive and should be added only if there is some specific cause for believing fish contamination or food chain biomagnification may be a problem.

Other analyses such as organics and heavy metals should be performed on water and sediment samples if, like the fish flesh analysis, there is a reason for believing there may be a problem (e.g., industrial discharges, pesticide runoff).

Each Clean Lakes project is different due to its specific objectives, available resources and lake characteristics, and, as such, each project should have its own individual monitoring program, based on its own specific needs and characteristics. EPA Project Officer approval of the monitoring program is required before sampling is initiated.

10.2.2 Physical Measurements

Physical features of a lake include morpho-

metry, hydrology, temperature, and light penetration. Table 10-1 lists the physical parameters that should be determined for a lake. Appendix E describes specific methods for collecting field data and performing the necessary calculations to meet the requirements in the table.

Lake surface area may be measured by planimetry from an accurate map of the lake. The determination of lake volume and mean and maximum depths requires a map with bottom contours (bathymetric map). If one has not already been prepared, a bathymetric survey must be performed. The survey method selected should depend on the accuracy required (dredging projects require more precise maps) and the available funds. A sophisticated survey of a large lake is usually very expensive since it requires surveying the lake, installing survey stakes, renting an expensive sonar unit, and expending a considerable amount of time in performing the survey. For many lakes, a satisfactory bathymetric survey can be performed manually with a sounding line to measure depth and an accurate map to estimate position.

Mean depth, maximum depth, and volume can be determined from the bathymetric and surface area maps, using procedures described in Appendix E. This information is important for calculating residence time, developing suggested maximum phosphorus loading rates, and designing pollution control and lake restoration measures.

A lake's hydraulic budget is used in calculating nutrient budgets and selecting and designing pollution control and restoration alternatives. This budget, discussed further in Appendix E, is normally quantified on the basis of the height of water spread over the entire lake surface entering or leaving the lake in a year's time. The storage term is positive if the level increases in the period and negative if it decreases.

The most general expression of a lake's hydraulic budget is:

$$\Delta S = P + I + U - E - O - R$$

where:

- ΔS = change in storage
- P = precipitation
- I = inflow from surface streams
- U = subsurface inflow through lake bottom
- E = evaporation
- O = flow through surface outlet
- R = outflow through lake bottom.

After the surface outflow is established, the water residence time and its reciprocal, the flushing rate, may be calculated (see Appendix E). These rates are variables in a number of models which may be used to analyze lake and watershed data during a Phase 1 study (see Subsection 10.6).

Temperature-depth profiles should be determined for the lake at each in-lake sampling station. Temperature profiles are normally determined by electronic probe, often in conjunction with a dissolved oxygen or multiple-variable probe. They are used to determine the extent of stratification and identify the boundaries between epilimnion, metalimnion, and hypolimnion in stratified lakes.

The Secchi disk measurement is a simple but effective and widely-used method of determining the transparency in a lake by measuring the depth below the surface at which a 20-cm disk can be seen. While not a direct measure of light penetration, it does have some relationship to it; the Secchi disk depth has been shown to approximate the level of penetration of 5 to 15 percent of solar radiation of visible wavelengths

Table 10-1
Morphometric and Hydraulic Parameters for Lake Analysis

Quantity	Symbol	Unit of Measurement
Lake Surface Area	A	Hectares or Square Meters
Mean Depth	$\bar{z}$	Meters
Maximum Depth	z_m	Meters
Lake Volume	V	Cubic Meters
Hydraulic Budget:		
Precipitation	P	Meters/year or Volume/year
Groundwater Inflow	U	Meters/year or Volume/year
Evaporation	E	Meters/year or Volume/year
Surface Outflow	O	Meters/year or Volume/year
Groundwater Outflow	R	Meters/year or Volume/year
Water Storage	S	Meters/year or Volume/year
Water Residence Time	τ	Years
Flushing Rate	ρ	Year ⁻¹
Temperature	T	Celsius
Secchi Disk Depth	SD	Meters

(Hutchinson, 1957). Consequently, the Secchi disk gives an underestimated but useful indication of the depth at which algae and macrophytes will grow. It is also a relative measure of turbidity caused by algae and/or suspended sediment. Secchi disk readings range from a few centimeters in highly turbid lakes to over 30 meters in extremely clear ones (Hutchinson, 1957).

10.2.3 Chemical Measurements

Chemical measurements include regular monitoring of constituents in the water column of a lake, plus sediment analyses under certain circumstances. Required chemical parameters and the procedures for analyzing them are presented in Table 10-2. Sample collecting, handling, and analysis are discussed in more detail in Appendix E.

Table 10-2
Physical and Chemical Parameters
for Trophic Condition Analysis

Quantity
Temperature
Secchi Disk Transparency
Suspended Solids
Dissolved Oxygen
pH
Alkalinity (Total)
Dissolved Orthophosphate-Phosphorus
Total Phosphorus
Ammonia—Nitrogen
Nitrite—Nitrogen
Nitrate—Nitrogen
Total Kjeldahl Nitrogen

Dissolved oxygen is the amount of oxygen in solution in the water and thus available to aquatic organisms. It is sometimes described in terms of "percent saturation," the concentration present as a percentage of the equilibrium amount that can be dissolved in the water at ambient water temperature and atmospheric pressure. Supersaturated conditions (greater than 100 percent) are often observed during daylight hours when algal biomass is high. Oxygen depletion results when plant and animal respiration and decay of organic material remove dissolved oxygen from water faster than it is replaced by reaeration or photosynthesis. Concentrations below 4.0 mg/l are generally recognized as unsuitable for maintenance of populations of most species of fish and other aquatic life (NAS-NAE, 1972).

Hydrogen ion concentration, or pH, influences the solubility and chemical form of many other substances in the lake. Some toxic substances are more harmful to aquatic life at one pH than another. The composition of lake plant and animal communities is strongly influenced by pH.

For this reason, alkalinity is an important parameter; it indicates the degree of buffering, or the ability of the lake to resist biologically disruptive variations in pH resulting from introduction of acids, bases, or salts into its waters.

Dissolved orthophosphate is thought to approximate the soluble reactive phosphorus that can be immediately used by photosynthetic organisms. Total phosphorus includes orthophosphate, hydrolyzable phosphorus (polyphosphates), and organic phosphorus in the soluble or particulate forms. Non-reactive forms may be converted to dissolved orthophosphate (the reactive form) by biological decomposition and chemical reactions.

Total Kjeldahl nitrogen is a measurement of free ammonia plus organic nitrogen compounds. Organic Kjeldahl nitrogen is thus the difference between total Kjeldahl nitrogen and ammonia.

Nitrite, which readily oxidizes to nitrate, is produced by bacteria-mediated oxidation of ammonia. Conditions rarely exist where it is an important constituent. Ammonia tends to predominate in anaerobic waters, and nitrate under aerobic conditions. Both ammonia and nitrate are readily usable by photosynthetic organisms (Hutchinson, 1957).

Table 10-2 presents the minimum number of chemical parameters needed to evaluate the nutrient-related trophic condition of a lake. Other parameters should be measured if specific lake problems are observed or suspected. For instance, toxicity problems would require the measurement of heavy metals, pesticides, or other appropriate toxic parameters.

Bottom sediment core samples should be collected and analyzed when dredging is being considered as a restoration technique. A sediment nutrient profile is needed to specify the amount of dredging required to eliminate nutrient-rich material. Sediment samples must be analyzed for phosphorus, nitrogen, heavy metals, and synthetic organic chemicals, as appropriate, using methods approved by the EPA Project Officer. Regulations further require that an elutriation test be performed for the same constituents according to procedures developed by the U.S. Army Corps of Engineers (see Appendix E). This test is designed to help predict what substances may be released from the sediment during dredging and after the dredged material is placed at its disposal site. Stauffer (1980) describes sampling methods useful for the analysis of bottom sediments.

10.2.4 Biological Measurements

In studying a lake for a Phase 1 or Phase 2 project, the phytoplankton characteristics of the lake should be examined. It is also important that macrophyte coverage be determined and biological resources such as fish populations be

assessed. Standard bacteriological analyses should be performed when the lake is used for contact recreation or fishing. Where the latter use occurs, the suitability of fish flesh for human consumption should be checked if toxic pollutants are known or suspected to be present in the lake. Biological measurements of secondary importance include primary productivity measurements and population studies of the zooplankton and benthic macroinvertebrates. Table 10-3 summarizes typical biological measurements for a lake. More details on methodology are presented in Appendix E.

Table 10-3
Biological Measurements for Lake Monitoring

Measurement	Test
Algal Pigment	Chlorophyll <i>a</i>
Algal Genera Identification and Cell Densities	Counting Chamber
Algal Cell Volumes	Calculation from densities and average cell volume
Limiting Nutrient	Algal Assay Bottle Test or Total N:Total P Ratio
Macrophyte Identification and Coverage	Observation and Photography
Bacteriological	Fecal Coliforms
Fish Flesh Analyses	Heavy Metals; Synthetic Organic Chemicals

The phytoplankton population must be measured in terms of chlorophyll *a*, cell densities, and volumes of the major genera. Cell volumes can be determined by multiplying cell densities by factors derived from direct optical measurements of the volume occupied by individual algal cells of each major genus. Samples for these analyses should be collected as outlined in Appendix E.

The nutrients required for algal growth are carbon (C), oxygen (O), hydrogen (H), nitrogen (N), phosphorus (P), and a variety of other elements in trace amounts. C, H, O, and the trace elements are almost invariably present in quantities that are more than adequate. In freshwater lakes P or, much less frequently, N is the nutrient that is in shortest supply relative to the nutritional needs of algae; it is the "limiting nutrient." Algal growth may stop when the available amount of the limiting nutrient is exhausted, regardless of how abundant the other nutrients may be. The most precise method for determining the limiting nutrient is an algal assay bottle test, described in more detail in Appendix E and the reference cited. A less reliable but usually satisfactory method is to calculate the total N: total P ratio in the water (see 10.6.2 and Appendix E).

10.3 Stream Monitoring

10.3.1 Stream Monitoring Methodologies

In a Clean Lakes Project, stream monitoring is usually performed to calculate a nutrient budget or to evaluate watershed management practices. In either case, the basic concept is to obtain sufficient data to calculate nutrient loadings to the lake. This entails calculating the amounts of nutrients transported, for which both flow and concentration data are needed. If the appropriate conversion factors are used, transport may be calculated as the product of flow and concentration. However, since concentration and flow samples are not always taken concurrently (e.g., preferred sampling methods include continuous flow monitoring with periodic concentration sampling), transport determinations are sometimes more representative when statistical estimation methods (e.g., regression) are employed (Reckhow, 1979b; Reckhow and Chapra, 1981).

Stream data should be collected in both dry and wet weather, since the annual nutrient transport by a stream is the sum of the dry weather (baseflow) loadings and the wet weather (or stormwater runoff) transport. Dry weather stream conditions are usually characterized by steady-state or quasi-steady-state conditions — that is, conditions where stream flow and nutrient concentrations are relatively stable and do not fluctuate significantly. Wet weather conditions, on the other hand, are characterized by dramatic changes in stream flow and nutrient concentrations illustrated in Figure 10-1.

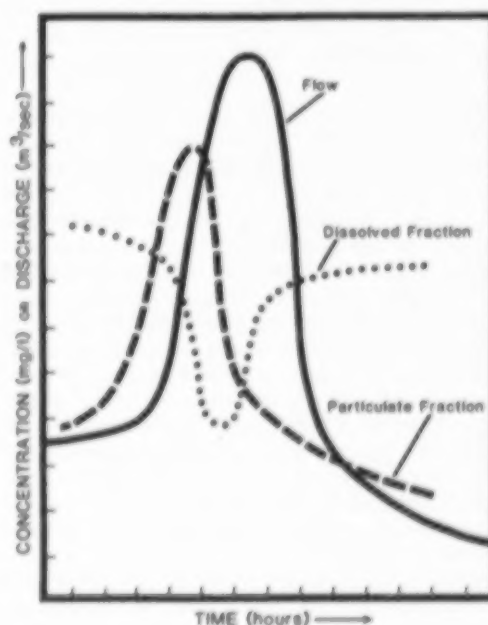


Figure 10-1. Typical nutrient concentration-stream discharge relationship.

Both dissolved and particulate fractions respond to storm events differently. The initial increase in streamflow is often associated with a decrease in the dissolved nutrient fraction. This decrease is attributed to the dilution effect of the greater runoff volume, resulting in the lowest dissolved concentration at the peak of the hydrograph. As flow rates decrease, the dissolved component tends to gradually increase to concentrations approaching that of the pre-storm baseflow conditions. For the particulate (or sediment) fraction, a different response is evident. During the initial rapid rise of the hydrograph, the particulate component increases dramatically, often reaching a maximum concentration preceding peak flow. This phenomenon, often referred to as "first flush," is the result of the dislodging of particulate matter from the land surface during the initial stages of runoff, leaving little material for transport at later periods. Regardless of where the particulates "peak out" relative to the hydrograph peak, a decrease in flow is accompanied or preceded by a decrease in particulate concentration (Reckhow et al., 1980).

Because of steady-state dry weather conditions, dry weather stream monitoring can usually be accomplished by collecting a grab water sample and measuring stream flow concurrently on a basis ranging from once per week to once per month, depending on the variability of the stream and the available project resources. It should be noted, however, that this method does not permit calculation of the precision of the transport estimate. Therefore, it is preferable that, whenever possible, flow be continuously monitored. Transport and transport precision may then be estimated statistically (Reckhow and Chapra, 1981). Data collected from frequent sampling at the beginning of a study may provide the basis for requesting the EPA Project Officer's permission to reduce the sampling frequency later on.

Wet weather monitoring is more complex than dry weather monitoring primarily because of the time-variable flow and concentration conditions that occur. Stormwater runoff is the excess rainfall that runs off the land surface, and is a function of amount, intensity, duration and spatial distribution of rainfall. It is also a function of soil type, soil moisture, cover, slope and temperature (season of the year). Other factors, such as man's activities, also influence the amount and quality of stormwater runoff. Because of the complexity of stormwater runoff, the sampling methodology used to collect stormwater samples is extremely important.

Grab sampling is usually inappropriate for wet weather stream sampling because the concentrations of most materials vary with stream flow or discharge. Flow-proportional composite sampling is the usual method for wet weather condi-

tions. There are a number of ways it can be accomplished, either manually or automatically; they are discussed in Appendix E.

10.3.2 Developing a Stream Monitoring Program

Like the design of a lake monitoring program, the design of a stream monitoring program must consider the project objectives (Phase 1, Phase 2, level of detail required, etc.), available resources (funds, equipment, laboratory, technical expertise, etc.), and watershed characteristics (number of major tributaries, land use, point sources, etc.). The stream sites should be selected to provide the maximum amount of useful data or information subject to the level of effort or cost that may be allocated to sampling. Existing data suggest that the frequency of non-storm event concentration sampling be once every two to four weeks for sampling and information efficiency (Reckhow, 1979b). Spatial coverage among tributaries is a function of magnitude, variability, and cost (or ease) of sampling. This can be interpreted to mean that more sampling should occur in tributaries that transport large quantities of phosphorus, or in tributaries that exhibit great variability in phosphorus transport, or in tributaries that are sampled at low cost. The basic stream monitoring program, therefore, should include the major inflows and outflows for the lake. And, as discussed in previous sections, both dry and wet weather monitoring should be performed.

Existing sources of data should not be overlooked. They include U.S. Geological Survey stream flow and quality data, State pollution and water resources agency data, and water treatment plant monitoring data. At a minimum, they will be helpful in designing a stream sampling program, and they may eliminate the need for some additional data collection.

In selecting a specific stream site, the following general criteria should be considered (Shelley, 1977):

- Accessibility and safety.
- Absence of extraneous or confusing inflows or waste streams, or other conditions which may make the sample unrepresentative.
- Sufficient distance downstream from tributary inflow or other discharges to ensure proper mixing at the site.
- Location whenever possible in a straight length of channel.
- Location where there is sufficient turbulence to produce adequate mixing and avoid the possibility of sedimentation.
- Location cost-effective relative to installation costs versus data needs.

It will usually not be possible to monitor all the tributaries entering some lakes, but the hydrological and water quality data can some-

times be transferred to ungaged streams using regression analyses and other statistical relationships.

10.3.3 Manual vs. Automatic Monitoring

Manual monitoring is collection of discrete samples and flow measurements by a field technician. The samples may be composited prior to analysis or analyzed separately. Automatic monitoring usually involves an automatic water sampler coupled to a recording flow meter to collect either discrete or flow-proportional composite samples and to measure flow continuously. The decision whether to sample manually or to use automatic samplers is not straightforward, and many projects require a combination of the two. The following criteria may be useful in deciding when to apply each method:

Manual Sampling

- Usually best for collecting biological or sediment samples, for infrequent collection of samples, for investigating special incidents, and for sites that are inappropriate for automatic samplers.
- Usually best for conducting wet weather studies of medium to large streams where the stream hydrograph is relatively long (requiring several days or more to rise and fall).
- Suitable at times for monitoring direct runoff from an undeveloped or agricultural area if the storm hydrograph is long.
- Usually required for sampling large rivers, estuaries, and lakes.
- Requires that field personnel be trained in order to provide reproducible results.
- Usually has higher personnel costs than automatic sampling.
- Does not require the purchase of sophisticated sampling equipment.

Automatic Sampling

- Best for sampling small streams and direct runoff sites where the storm hydrograph is relatively short, having a quick rise and fall.
- Indicated where frequent sampling is required at a site, where long-term compositing is needed, and where simultaneous sampling at many sites is necessary (Shelley, 1977).
- Usually recommended for outfall or treatment plant monitoring where 24-hour (or greater) composites are required.
- Usually requires less personnel time, but there may be a need for periodic (often daily) site visits and equipment maintenance and repair.
- Equipment is subject to vandalism.
- Usually requires some manual sampling to check the operation and accuracy of the equipment and to measure parameters that are perishable or cannot be meaning-

fully measured from samples collected by automatic equipment (e.g., pH, temperature, dissolved oxygen, coliform bacteria).

10.3.4 Equipment Requirements

Typical equipment requirements for a Phase 1 study (and some types of Phase 2 projects) include an automatic sampler, recording flow meter, primary flow measuring device (weir, flume, etc.), rain gage, and dry/wetfall sampler. These instruments are coordinated to provide the information necessary to evaluate dry and wet weather loadings to a lake, including rainfall (rain gage), stream or runoff flow (flow meter), chemical water quality (sampler), and loading contribution from airborne contaminants and rainfall (dry/wetfall sampler).

Samplers: There are many automatic samplers commercially available. The better models can be programmed to operate in any one of several sampling modes. Most can be operated from flow or volume signals transmitted from a flow meter. Samplers usually can be ordered to operate from AC or DC power, and can be either portable or fixed installation. Capital costs range from \$500 to \$5,000 (1980 prices), depending on the manufacturer and the options included on the sampler. A listing of manufacturers and characteristics of samplers, and criteria for selecting among them, is presented in the report by Shelley (1977).

Desirable features of an automatic sampler include simplicity of maintenance and troubleshooting, availability of parts, availability of service and repairs by the manufacturer, and the inherent reliability of the sampler. As a general rule, complexity of design should be avoided even at the expense of some flexibility in operation; a reasonably representative sample collected most of the time is preferable to a very representative sample collected only 10 percent of the time (Shelley, 1977). Specifications of samplers from several manufacturers should be carefully reviewed and demonstrations requested prior to selecting a given sampler.

Flow Meters and Measuring Devices: Measurement of stream flow is usually accomplished by installing either a manual or automatic stage measuring device at a selected stream station. Over a period of time designed to obtain both low and high stream flows, the stage height (water level) of the stream is measured along with stream flow, and a relationship between stage height and stream flow is statistically established.

The stream flow is usually calculated by measuring the stream velocity and depth at various locations across the stream with a current meter. The cross-sectional area of the stream is calculated from the depth and stream width data. Stream flow is then calculated using the continuity equation:

$$Q = AV$$

where Q = stream flow
 A = cross-sectional stream area
 V = average stream velocity.

Manual stage measurement devices include a simple staff gage installed adjacent to the stream bed or a drop line that is usually attached to a bridge. Both of these devices only provide instantaneous stage readings and thus require increased personnel time to obtain sufficient stream flow data.

Automatic stage height recorders are preferable and should be installed whenever time and resources permit. They can provide continuous stream flow measurements during both dry and wet weather, insuring that the wet weather data needed to calculate annual nutrient loadings to a lake are available. Manual stream flow measurement is a less reliable way to obtain an adequate number of observations because of the unpredictable nature of rains, the discomfort and hazard factor in making measurements during storm events, and the time-variable nature of wet weather flow which necessitates measurements at intervals during a storm. Rains that occur on weekends, holidays and during the night are often not measured when manual methods are used.

Measuring stormwater runoff from various land uses or from small sub-basins can be accomplished by monitoring stage heights as described above if channel conditions are suitable and stable. However, direct stormwater runoff from small catchments is usually measured by installing primary measurement devices such as weirs and flumes. These devices provide the flow rate if the height of flow through the device is known. The height of flow is usually measured with a portable water level meter and recorder.

10.4 Quality Assurance

No monitoring effort can be better than its quality assurance program. Every Clean Lakes Program project is required to have a quality assurance program for both field and laboratory activities which complies with the Quality Assurance Program Plan developed by EPA's Office of Water Regulations and Standards.

Quality assurance seeks to establish the accuracy and precision of measurements and to maintain high standards for both. It also seeks to maximize the completeness, representativeness, and comparability of all data collected. Accuracy refers to the degree of agreement between a measurement and its true value. Any discrepancy is known as error. Errors may be systematic, i.e., due to procedural or equipment failures, or random. Random errors may arise from many potential causes, which are largely undefinable and outside the observer's control. Precision refers to the reproducibility of a measurement when repeated on identical samples,

regardless of its proximity to true value. Completeness is a measure of the amount of valid data actually obtained compared to the amount expected. Representativeness means the degree to which data accurately and precisely describe a characteristic of the system under study. Comparability is a measure of the confidence with which one data set can be compared to another.

To meet OWRS requirements, the work plan and operating procedures for each Clean Lakes project must incorporate quality assurance considerations at four stages in the monitoring program: planning and design, field activities (data gathering), laboratory activities (data analysis), and data management.

Planning and design is the basic stage where a study's objectives are established, and plans are made to meet these objectives. The following considerations are important in this process:

1. The intended use of the data, including one or more of:
 - a. Screening—determines the presence or absence of specified pollutants at designated sites;
 - b. Quantitative estimation—determines the concentration of pollutants found in screening;
 - c. Problem characterization—uses data from (a) and (b) to characterize problems, conditions, and trends at the project site;
 - d. Regulatory development—leads to regulations or appropriate measures to deal with the problems;
 - e. Enforcement—puts into effect and maintains regulatory measures developed.
2. The assurance of representative sampling to ensure that the study objectives are met. Decisions to be made include determining what types of material are to be sampled (soil, water, sediments, etc.), under what conditions (weather, flow, etc.), at which sites, how often, and for how long.
3. Planning for sufficient and proper specific quality assurance activities throughout the study.

Field activities (data gathering) must be conducted in a prescribed manner to ensure that the samples obtained at the project site are of appropriate quality and reliability. EPA has standards for equipment, instruments, and containers, and for sampling techniques, recording, preservation, packaging, and identification.

Laboratory activities (data analysis), after the samples are shipped to the laboratory, also fall under the quality assurance guidelines. Requirements include:

1. Use of proper preparation, analytical, and documentation methods;
2. Use, calibration, and maintenance of

EPA-approved laboratory instruments and equipment;

3. Maintenance of an adequate procedural QA program, which incorporates reference samples, quality control samples, correct statistical procedures, reviewing of results, training, trouble-shooting, documentation, and evaluations of the laboratory by outside analysts.

After data have been collected and analyzed, they must be properly managed. This includes submission for entry into EPA's STORET system (see Appendix G). Quality assurance is vital here also, as data can be lost or misinterpreted, and errors can be introduced during this process. The data analyst and the person who enters the data into the storage system must make proper checks at all data handling points. In addition, the data must be recorded on, and transferred and reduced from, the original lab bench data sheets in a complete and accurate manner. They must be organized into a logical and acceptable standard format, be periodically checked, and be retained, in original form, in a permanent file. The data storage and information system must be capable of receiving, screening and validating, preparing, sorting, and inputting the data. The system must also be able to relate the data to the quality control measures used in the data gathering and analysis processes. The data should be made readily available to potential users.

Details on the various aspects of quality assurance are presented in Appendix E. States should work with EPA Project Officers in formulating quality assurance procedures for Clean Lakes projects.

10.5 Land Use Monitoring

Land use monitoring may be performed in a Phase 1 study to determine and compare nutrient loadings contributed by various land uses. Although there is much national data of this kind in the scientific literature (see Appendix C and Reckhow, et al. 1980), site-specific monitoring is sometimes advisable if the land use, associated activity, or regional characteristics are significantly different than those reported in the literature. It must be noted, too, that use of literature export coefficients (as opposed to direct sampling of nutrient loading) represents a cost savings in data acquisition that may be at the expense of increased planning risk because of nonrepresentativeness of the export coefficients. Also, the implementation of a watershed management plan is usually more acceptable to public officials and citizens when data obtained in the lake's own watershed are available to substantiate the management plan. Another reason for land use monitoring is that national loading values are frequently vague concerning actual site conditions (slope, soil type, etc.), and this

limits their transferability. Reckhow et al. (1980) is one exception in that export coefficients are tabulated along with important characteristics of watersheds studied.

Land use monitoring is usually accomplished by selecting representative sites and installing primary flow measuring devices, automatic samplers and flow recorders as discussed in Section 10.4. Manual monitoring is not recommended unless the area is relatively large, rural or agricultural in nature, and has a long storm hydrograph (lasting several hours or longer).

Sites should be selected so that the stormwater drains to one discharge point, avoiding the need to install more than one monitoring station per land use site. The selected land use should be representative of existing or projected land uses in the watershed. In selecting a site, consideration should be given to slope, soil type, drainage density, development density, percent impervious area, activity, and other factors. The sites should be monitored for at least one year to measure seasonal differences caused by changes in temperature, ground cover, and land use activities.

10.6 Data Management and Analysis

10.6.1 Manual Versus Computerized Data Management

An early decision in the experimental design of a lake management program involves whether the data collected will be logged and analyzed by manual or computerized techniques. This decision depends largely on the amount and type of data that will be generated, the objectives of the program, the type of expertise available and the project budget.

Manual data management is recommended, in general, when the data set will not be large and when many different types of data must be logged, necessitating numerous formats, each with its own computer programming requirements. It is especially important to adopt and use well-organized record-keeping practices when data are handled manually. In contrast to the computerized alternative, manual data management requires more specific attention to carefully prepared records, which will often not be analyzed for months. It is wise to produce duplicates of all hard-copy records and store them in separate locations to reduce the risk of data loss.

Relative to computerized, the advantages of manual data management include its simplicity, less need for technician training, and lower cost (when data are not profuse). On the negative side, manual data handling can be unwieldy and inflexible and can require burdensome typing when data are assembled for presentation in a report.

Computerized data management should be considered when the data set will be large and

when similar types of data allow relatively simple programming formats. A major advantage of computerized data handling is the flexibility to apply readily available numerical analysis and statistical packages to analyze data trends and interrelationships. Other prepared programs are also marketed to perform the basic task of filing data, and these should be investigated before a programming effort is undertaken. In addition to the advantages rendered by these developments, computerization can also quickly produce data tables for placement in reports.

10.6.2 Analysis of Lake Data

Chief concerns of lake data analysis are to determine the trophic state; to evaluate phytoplankton growth patterns in response, principally, to the limiting nutrient; and to identify and quantify other water quality problems. More fundamentally, the data set must also be reduced to express the key variables in terms of a few well-chosen summary statistics (e.g., mean and range). This latter requirement is necessary partially to serve the aforementioned purposes and partially to apply the predictive methods discussed in Section 10.6.5. Reckhow (1980) and Reckhow and Chapra (1981) contain extensive presentations on the statistical methods important in analyzing and summarizing lake quality data.

An initial data analysis requirement is to identify the limiting nutrient. Properly performed, algal growth bioassays usually clearly reveal the nutrient, almost always phosphorus or nitrogen, which is limiting to phytoplankton growth. Additional evidence can be obtained by comparing the weight ratio of total nitrogen to total phosphorus in the water to the typical ratio of these elements in algal tissue, approximately 15 to 1. When the N:P ratio is less than 15:1, nitrogen is probably the limiting nutrient; when it exceeds 15:1, the limiting nutrient is probably phosphorus (Porcella, et al. 1974).

The parameters which are most important to characterize on the basis of seasonal patterns and mean values are:

- Total soluble reactive phosphorus (dissolved orthophosphate phosphorus)
- Total phosphorus
- Chlorophyll *a*
- Secchi disk depth.

The behavior of dissolved orthophosphate during the prime growing season is indicative, to a degree, of the level of phytoplankton productivity. Phosphorus depletion often occurs during algal blooms in eutrophic lakes, when concentrations are reduced by "luxury" consumption, in excess of needs, by algal cells.

Winter total phosphorus concentration is widely used in trophic state classification systems and simple predictive models developed for phosphorus-limited waters. Although

phytoplankton cannot immediately use all the forms of phosphorus represented in the total phosphorus measurement, its adoption for these purposes presumes that solubilization between winter and spring or summer will make available at least some phosphorus initially held in forms other than dissolved orthophosphate.

Common trophic state classification schemes and models are also based on summer chlorophyll *a* concentration and Secchi disk depth, as measures of algal biomass and its visible effects.

Trophic state can be projected on the basis of nutrient loading by means of the graphical technique of Vollenweider (1975) (Figure 10-2). The graph permits placing a lake in oligotrophic, mesotrophic, or eutrophic categories depending on mean depth ($\bar{z}$), hydraulic residence time (T_w) and annual phosphorus loading (see Subsection 10.6.4). One must note, however, that this is simply a graphical presentation of the input-output model (Subsection 10.6.5), and thus it contains considerable prediction uncertainty.

An alternative to the projection of trophic state using an empirical loading model is to relate in-lake data to trophic state. These trophic state definitions are based on total phosphorus, chlorophyll *a*, Secchi disk depth, primary productivity, and indicator organisms, especially algae. They have been developed by many investigators but have been summarized by Welch (1980).

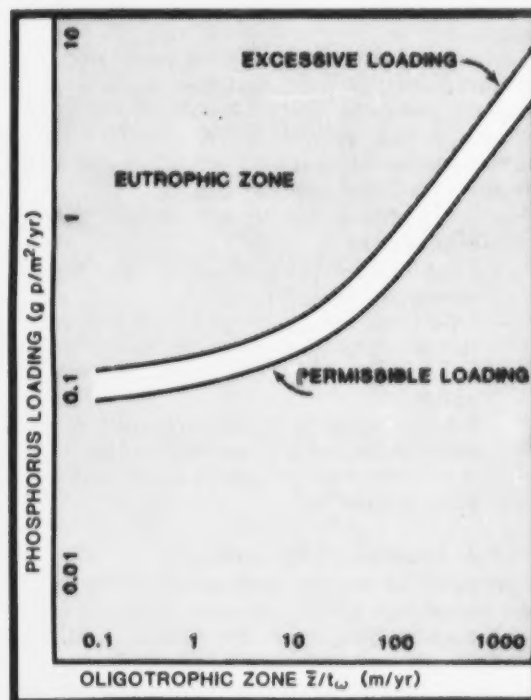


Figure 10-2. Trophic state in response to phosphorus loading (Vollenweider, 1975).

Table 10-4 presents some of the various quantitative definitions. The choice between a trophic state assessment based on an empirical loading model or one based on in-lake data must be made on the basis of data availability and the purpose for trophic state determination. When indifferent about the use of these two approaches, the in-lake data base is preferable because it entails less prediction error.

Table 10-4
Summary of Quantitative Definitions
of Lake Trophic State

Characteristic	Oligotrophy ^a	Eutrophy ^a
µg TP/l (Winter)	≤ 10 - 15	≥ 20 - 30
µg Chlorophyll <i>a</i> /l (Summer)	≤ 2 - 4	≥ 6 - 10
m Secchi Disk Depth (Summer)	≥ 3 - 5	≤ 1.5 - 2
Primary Productivity:		
mg C/m ² /day	30 - 100	300 - 3000
µg C/m ² /yr	7 - 25	75 - 700

^a Mesotrophy exists between the limits for oligotrophy and eutrophy.

The phosphorus loading, phosphorus concentration, chlorophyll *a*, Secchi disk depth, primary productivity, and indicator organism criteria presented in Table 10-4 can be applied independently to estimate the trophic state of a lake being considered for restoration. More importantly, they can be used to set targets for reduction of nutrient loadings by watershed management, and for water quality improvement through a combination of management and application of in-lake treatments.

When public health problems associated with contact recreation exist, results of bacterial analyses on lake water can be helpful in identifying causes in the watershed. Fecal coliform/fecal streptococcus ratios (FC/FS) and their use as indicators are listed below:

- ≥ 4.0 indicates pollution derived from human wastes.
- 2.0-4.0 suggests a predominance of human wastes in pollution.
- 1.0-2.0 represents a "gray" area of uncertain interpretation. Samples should be taken nearer the suspected source of pollution.
- 0.7-1.0 suggests a predominance of livestock or poultry wastes in mixed pollution.
- ≤ 0.7 indicates pollution derived from livestock or poultry.

10.6.3 Analysis of Stream Data

Analysis of stream data usually emphasizes the calculation of nutrient and sediment transport by summing both dry-weather and wet-weather (stormwater runoff) values. Dry-weather transport can be calculated using several methods, depending on the available data and the degree of accuracy desired. If continuous flow data are available, the annual loading is

best calculated using the statistical method of regression analysis (Reckhow and Chapra, 1981). This method allows the analyst to examine the relationship among flow, concentration, and loading. If a statistical relationship (correlation) exists, then this can be exploited in a superior model for loading. If no correlation exists among flow, concentration, and loading, the annual loading can be calculated by multiplying the nutrient concentration by the stream flow. This can be done by calculating an average annual concentration, applying it to the daily base flow, and summing the individual results.

For wet-weather transport, it is usually necessary to develop statistical relationships between nutrient loadings and stormwater runoff (Browne and Bedient, 1977). If continuous flow data are available, these loading relationships can be applied to the stormwater volumes measured over the year. The total wet-weather (nonpoint source) stream loading is calculated by adding the loadings from individual storms. The total annual loading is calculated by adding the dry- and wet-weather loadings.

If continuous flow data are not available, statistical relationships must be developed between stream flow and rainfall (usually the dry-weather flows can be estimated based on weekly or monthly measured flows), using existing observations of flow. After wet-weather flows are calculated, the above loading/runoff relationship can then be applied to the predicted stream flows to estimate the annual nutrient transport.

10.6.4 Calculation of Annual Nutrient Budget

The annual nutrient budget will usually consist of the following: stream inputs, direct drainage area input, point source inputs, septic tank and groundwater inputs, dryfall and wetfall (atmospheric) inputs, and other miscellaneous inputs. Whenever possible, the specific sources should be measured to provide specific data based on the annual period monitored. If unavailable, some of the sources can be estimated using literature values (Reckhow, et al. 1980) or methodologies used in the EPA National Eutrophication Study (Working Paper No. 75, 1975).

The annual nutrient budget should be standardized for the average year based on past rainfall records. For instance, if rainfall was lower than the annual average, the nonpoint source loading should be adjusted upward to account for this. The annual budget should reflect a typical year in the watershed. Nutrient budget calculations are described in Appendix E.

10.6.5 Prediction of the Effects of Watershed Management and Lake Manipulation

With the rapid advances in knowledge concerning lake ecology in the past 15 years came a

desire by many scientists to construct mathematical models of natural systems which would allow prediction of the consequences of altering conditions. These models are of two fundamental types:

- Deterministic, in which model components are assumed to be fixed in value. Error and variability are ignored in model applications, leading to fixed value predictions.
- Stochastic, in which natural variability and/or modeling error are incorporated into the modeling process. Predictions may be expressed probabilistically or in other forms that reflect the inherent uncertainty.

Deterministic models range from quite simple algebraic expressions of a single phenomenon to highly sophisticated, multi-parametric computerized models which link the various ecosystem compartments. These advanced simulation models, of course, require far more data to use than the simpler alternatives. Even with their complexity and supposed generality, they do not always do a better job of representing specific aspects of the more complicated natural system than well-conceived and properly used elementary models. This manual will discuss only simple and widely verified deterministic models. As will be more specifically emphasized in the discussion, these models have definite limitations in both applicability and capability. They must therefore be used with great care and applied by scientists very familiar with their theoretical and empirical bases.

Several researchers have developed simple models linking phosphorus concentration and loading on the basis of a linear first order differential equation expressing the phosphorus mass balance in a lake:

$$\frac{dP}{dt} = \frac{LA}{V} - \sigma P - \frac{QP}{V} = \frac{L}{z} - (\sigma + p)P$$

where:

- P = total phosphorus (usually taken as mean concentration during the winter equilibrium condition between fall and spring turnovers, in mg/m³ or µg/l)
- L = P loading (mg/m²/yr)
- A = lake surface area (m²)
- σ = phosphorus sedimentation rate (yr⁻¹)
- Q = annual outflow rate (m³/yr)
- V = lake volume (m³)
- z = mean depth (m)
- p = flushing rate (yr⁻¹)

Table 10-5 lists the basic mechanistic forms of the steady state solution to a phosphorus mass balance like that presented above. These mechanistic models may be applied after empirical es-

timation of the model parameters (σ, R, and V_s). In addition to the original sources given in Table 10-5, Welch (1980) summarizes the models and their backgrounds, and Reckhow (1979a) describes and compares a number of them.

Table 10-5
Common Forms of Loading Concentration Models
Based on Phosphorus Mass Balance

Form	Reference	Remarks
$P = \frac{L}{z(p + \sigma)}$	Vollenweider (1969)	
$P = \frac{L(1 - R)}{zp}$	Dillon (1975)	R = phosphorus retention coefficient (1 - $\frac{\text{total export}}{\text{total loading}}$)
$P = \frac{L}{V_s + Q_s}$	Chapra (1975)	V _s = apparent settling velocity (m/yr) Q _s = areal water loading (m/yr)

The steady-state solution of the model is developed under the following assumptions:

1. The lake is completely mixed at all times.
2. The rate of supply of phosphorus, the flushing rate, the lake volume, and the sedimentation coefficient are constant through time.
3. The outflow P concentration equals the lake P concentration.
4. The lake is in steady state; that is, phosphorus concentration does not change over time.

While there is probably no lake in which these assumptions hold at all times, empirical fitting of the model to a broad range of lakes has shown that the models will produce usable results (with broad confidence limits) even when the assumptions do not hold. Judgment is obviously needed in the application of these models.

The actual use of the simple input-output models (Table 10-5) requires an estimate of the sedimentation coefficient (σ), or the phosphorus retention coefficient (R), or the apparent settling velocity (V_s). If one has made a complete phosphorus budget for a lake, they can be calculated: $\sigma = L/z \cdot P - p$, or $R = 1 - (\text{annual P loss through outlet}) / (\text{annual P input})$ or $V_s = L/P - Q_s$. Various investigators have also derived empirical equations to calculate these parameters from other easily obtained data. Reckhow (1979a) and Reckhow and Chapra (1981) contain thorough summaries of these cross-sectional empirically fitted models. Model errors alone for these mod-

els typically run about ± 30 percent. As a result, model selection criteria may be less based on comparative errors and more based on a match between the model development data set characteristics and the application lake characteristics. The comparisons in Table 10-6 provide some guidance for model selection (from Reckhow, 1979a).

The primary use of these models in a lake management program is to predict the effects of changes in nutrient loading, hydraulic flushing rate, or mean depth on lake phosphorus levels and hence trophic state. To that end, Reckhow and Simpson (1980) and Reckhow, et al. (1980) provide a step-by-step procedure for the prediction of lake phosphorus concentration, and the estimation of the prediction error, associated with land use changes. Also included in Reckhow, et al. (1980) is a thorough compilation of phosphorus export coefficients. Because of the possible effects of internal phosphorus loading from the sediments, the models should work best in projecting the impacts of increased load-

ing such as might be found when an expanding city has a sewage plant effluent flowing into a lake. Next in effectiveness will be the impact of eliminating relatively short-term increases in nutrient loading such as the diversion of sewage effluents from Lake Washington in the 1960's (Edmondson, 1970). On the other hand, lakes that have been very heavily loaded over long periods of time may not demonstrate the calculated drop in phosphorus concentration. In Lake Trummen in Sweden, for instance, it was necessary to dredge out the nutrient-rich sediments before significant improvements were noted (Bengtsson, et al. 1975).

It has been suggested (Schindler, et al. 1977) that there is an equilibrium-type of relationship between the phosphorus concentration in the water and the phosphorus in the sediments. If enrichment lasts for only a relatively short period of time, the mixture of the recent sediments with those lying deeper dilutes the nutrient-release potential of the surface sediments so that, with a reduction of nutrient inputs, the internal loading from the sediments will not main-

Table 10-6
A Comparison of Empirical Models

Model	Data Base	Known Constraints*	Known Biases*	Consideration of Uncertainty	Comments
Constant V_s					
1) Vollenweider $V_s = 10$ m/yr	Unspecified	Unknown	Not evaluated	Not considered	Based on the range of apparent settling velocities observed in natural lakes (Reckhow, 1977), these models will probably overestimate P in lakes with high z/T and underestimate P in highly enriched lakes.
2) Chapra $V_s = 16$ m/yr	14 Canadian Shield lakes	$P < .015$ mg/l $LT/z < .050$ mg/l	Not evaluated	Not considered	
3) Dillon & Kirchner $V_s = 13.2$ m/yr	12 Canadian Shield lakes	$P < .015$ mg/l $LT/z < .050$ mg/l	Not evaluated	Not considered	
Constant Jones & Bachmann $= 0.65$ yr ⁻¹	51 natural lakes, primarily north temperate	Unknown	Not evaluated	Not considered	This model will probably overestimate P in shallow lakes with high values of z/T.
R_p - Regression					
1) Kirchner & Dillon R_{KD}	14 Canadian Shield lakes	$P < .015$ mg/l $LT/z < .050$ mg/l	Significant underestimation of P in lakes with $LT/z > .300$ mg/l	Not considered	RLM was found (Reckhow, 1977) to be less biased than R_{KD} for phosphorus-enriched lakes.
2) Larsen & Mercier R_{LM}	20 north temperate lakes, primarily oligotrophic	$P < .012$ mg/l $LT/z < .025$ mg/l	Significant underestimation of P in lakes with $LT/z > .300$ mg/l	Not considered	

tain previously high concentrations in the lake water. On the other hand, if high loadings have been maintained for a long period of time, high sediment concentrations may feed nutrients such as phosphorus back into the water and maintain the high phosphorus concentrations in spite of reductions in loading.

If internal loading as described above is not thought to be a problem, if the flushing rate is expected to remain constant, and if a reliable estimate of present phosphorus loading exists then it is possible to estimate the effect of a nutrient reduction without using one of the empirical equations. In the basic input-output model the phosphorus concentration is directly proportional to the loading rate. If P_0 is the present phosphorus concentration, L_0 the present loading rate, and L_r is the nutrient loading rate after a nutrient reduction program, then the new phosphorus concentration (P_r) will be given by: $P_r = P_0(L_r/L_0)$. This procedure can be used in the planning stages to estimate the effects of a particular nutrient reduction program. It should be kept in mind that because of year-to-year variations within a lake system, a nutrient reduction should

be significant (say at least 50 percent) if the effects are to be noticeable by the public. For lakes with very high algal levels (75 percent mg/m^3 chlorophyll *a*) even greater reductions may be necessary due to the nature of the relationship between Secchi disk transparency and chlorophyll *a* concentrations.

By solving the basic equation for the loading rate (L), the models can be used to estimate phosphorus loading when other quantities have been measured. This method of establishing P loading may be considered when support is insufficient to allow direct measurements or indirect estimates based on land use. This procedure may also be used as a rough check on other methods of estimating loading rate. It should be kept in mind that the confidence limits on loading estimated in this manner will be broad and the resulting value should be considered as an order of magnitude estimate.

Discussion of predictive models to this point has been confined to phosphorus loading and concentration relationships. Several statistical expressions have also been proposed to relate phosphorus, chlorophyll *a* (*chl a*) and Secchi disk

Table 10-6
A Comparison of Empirical Models (Continued)

Model	Data Base	Known Constraints*	Known Biases*	Consideration of Uncertainty	Comments
Reckhow Models					
1) Quasi-General Model	47 north temperate lakes	$P < .135 \text{ mg/l}$ $LT/z < .298 \text{ mg/l}$ $Q_a < 187 \text{ m/yr}$	None significant	Parameter errors and model error are presented so that the total uncertainty may be calculated. This permits the assignment of confidence limits to a prediction.	Linked to a graphical error analysis (Reckhow, 1977).
2) Oxidic, $z/T < 50 \text{ m/yr}$ lakes	33 north temperate lakes	$P < .060 \text{ mg/l}$ $LT/z < .298 \text{ mg/l}$	None significant		Smaller errors than R_{KD} and R_{LM} on independent data set (Reckhow, 1977).
3) $z/T > 50 \text{ m/yr}$ lakes	28 north temperate lakes	$P < .135 \text{ mg/l}$ $LT/z < .178 \text{ mg/l}$ $z < 13 \text{ m}$ $T < 0.25 \text{ yr}$	None significant		Verification not conclusive (Reckhow, 1977).
4) Anoxic lakes	21 north temperate lakes	$.017 \text{ mg/l} < P < .610 \text{ mg/l}$ $.024 \text{ mg/l} < LT/z < .621 \text{ mg/l}$	None significant		Needs to be verified.
Walker Model	105 north temperate lakes	Similar to those in Table 3A.2 (in Reckhow, 1977)	Not evaluated	Prediction confidence limits can be estimated.	No major shortcomings known.

*Constraints or biases that may significantly affect the value of the model for prediction purposes.
Source: Reckhow, 1979a

depth (SD). These appear in Table 10-7. The equations are available to estimate chlorophyll *a* and Secchi depth after phosphorus is established, either through measurement or by calculation using the models in Table 10-5. Estimated values may then be compared with the definitions of trophic state in Table 10-4. Alternatively, the data in the oligotrophy column of Table 10-4 may be selected as a restoration target and the regression equations solved for the phosphorus concentration goal to pursue. It may be noted that the linear regression equations of Dillon and Rigler (1974) and Jones and Bachmann (1976) closely correspond, although their bases are

somewhat different. While both explain a high percentage of the variation in the dependent variable, the confidence limits reported by Dillon and Rigler demonstrate that forecasts made using the equation could be substantially in error, so that a lake predicted to improve in trophic state might not do so in reality.

Canfield (1979) has shown that these equations do not work well for artificial lakes. This is apparently the result of higher levels of inorganic particles that reduce light penetration and algal production.

Vollenweider (1976) extended his phosphorus loading concept presented earlier to include its

Table 10-7
Empirical Relationships Between Phosphorus Concentration, Chlorophyll *a*, Secchi Disk Depth, and Hypolimnetic Oxygen Depletion Rate

Equation	Reference	Remarks
$\text{Log}(\text{Chl } a) = 1.449 \text{ Log}(P) - 1.136$	Dillon and Rigler (1974)	N/P 12 Percent variation explained = 90.3 Predicted (Chl <i>a</i>) Confidence Limits 95% 50% 0.75 0.27-2.08 1.06-2.53 5.61 2.06-15.3 4.00-7.87 21.2 7.69-58.4 15.1-29.8 57.8 20.6-162 40.8-81.9
$\text{Log}(\text{Chl } a) = 1.46 \text{ Log}(P) - 1.09$	Jones and Bachmann (1976)	Summer TP concentrations used Percent variation explained = 90.3
$\text{SD} = \frac{7.7}{\text{Chl } a^{0.66}}$	Carlson (1977)	Indicates that most change in SD occurs when chl <i>a</i> < 20 µg/l, with little additional deterioration of visibility above that level.
$\text{Log SD} = -0.359 \text{ Log} [(L(P)/q_s / (1 + z/q_s))] - 0.259$	Rest and Lee (1978)	Correlation coefficient = 0.77 Some chlorophyll <i>a</i> values reported were summer means while others were annual means.
$\text{Log SD} = -0.359 \text{ Log} [(L(P)/q_s / (1 + z/q_s))] + 0.925$	Rest and Lee (1978)	Relationship holds only for lakes where the primary factor controlling water clarity is phytoplankton and for lakes whose excessive phosphorus loadings are not manifested in the form of macrophytes.
$\text{Log HOD} = 0.491 [(L(P)/q_s / (1 + z/q_s))]$	Rest and Lee (1978)	Since the oxygen depletion rate is expressed on an areal basis, it can be applied to any hypolimnetic volume, regardless of size or oxygen content.
$\text{Pr}_{\text{oxic}} = \frac{1}{10^5 z - 2.49 L 2.00 q_s - 1.78 + 1}$	Reckhow (1978)	Pr_{oxic} is the probability that a lake will not develop anoxic conditions in the hypolimnion. This model was developed from a data set of 55 north temperate lakes (with $z > 3.0 \text{ m}$, $\tau > 0.25 \text{ yr}$, and $1 < q_s < 50 \text{ m/yr}$).

effect on chlorophyll *a* levels in lakes and reservoirs. This was done in order to produce a relationship which is more useful for water quality management purposes by making it possible to quantitatively predict the change in response of a certain eutrophication parameter for given loadings rather than forecasting the change which will occur in the more subjective classification of trophic status. Rast and Lee (1978), under the United States portion of the OECD (Organization for Economic Cooperation and Development) eutrophication project, have further extended the Vollenweider relationship to include the impact of a geomorphologically normalized phosphorus load on the Secchi disk depth and the hypolimnetic oxygen depletion rate. Recently, Vollenweider (1979) has formulated a similar relationship between phosphorus load and the primary production levels in a lake. In addition, Lee and Jones (1979) have added the

natural fish yield to the list of parameters which can be appropriately modeled by this approach. Caution must be observed in applying these relationships, however, since their breadth of coverage (loading to biomass) necessarily incorporates substantial prediction error.

10.7 Reporting Monitoring Data

It is important for overall project evaluation and for continuing assessment of lake restoration and protection technology that water quality and pollutant source monitoring data be assembled in a centralized location. EPA's STORET data management system is being used for this purpose. Appendix G contains instructions and data reporting formats which will facilitate data compilation by States and entry by EPA Regional Offices.

11.0 TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS

As discussed in earlier sections, the Clean Lakes Program provides up to \$100,000 per award and requires a 30 percent non-Federal share for Phase 1 diagnostic-feasibility studies. Phase 2 awards are available for pollution control and/or in-lake restoration methods; there is no specified maximum, but they require a 50 percent non-Federal share. Thus, significant amounts of money must be supplied by State, local, or private sources. As a general rule, Federal grant programs or other Federal moneys cannot be used to supply the State and local share; however, two exceptions do exist. The exceptions are the General Revenue Sharing Funds from the Department of the Treasury and the Community Development Block Grants from the Department of Housing and Urban Development, both of which may be used as a part of the State and local matching funds for the Clean Lakes Program.

11.1 Non-Federal Match

A number of States have set up specific programs to be used as non-Federal matching funds for the Clean Lakes Program. Others have programs which, although not specifically designed for that purpose, could be used to provide the local match (see Table 11-1). In the State/local section of the matrices, in Table 11-2, under the "Federal Program Matched" column, the phrase "314" denotes States with funded programs specifically designed to match the Clean Lakes funds, and "314 possible" denotes States where program funds may provide the match under certain conditions. Thirty-two States do not provide matching funds. Consequently, local units of government must provide all the matching funds for the Clean Lakes Program. However,

State technical and administrative assistance may be used as an in-kind match.

As can be seen in Table 11-2, most States have indicated that they do provide technical assistance which can be used as an in-kind match. Such State services as water quality monitoring and installation of monitoring equipment, laboratory services, and analysis of data can and have been used as the in-kind match. These services can also be provided at the local level and may include donated time and equipment from qualified local sources. Specific reference to using in-kind services is made in the hypothetical case in Section 12.0 of this manual.

Table 11-1
States with Programs to Match Clean Lakes Funds

Specifically Designed Programs	Programs Applicable Under Certain Conditions
Connecticut	Arizona
Florida	Arkansas
Massachusetts*	California
Maine*	Montana
Minnesota	Nebraska
New Jersey	Rhode Island
North Carolina	
Oregon*	
Puerto Rico	
South Dakota	
Washington**	
Wisconsin	

*Proposed.

**Proposed, Phase 2 only.

Table 11-2
Summary of Federal, State and Regional Programs

FEDERAL PROGRAMS	DEPARTMENT AGENCY PROGRAM NAME	TYPE OF ASSISTANCE				ELIGIBLE PROJECTS						ELIGIBLE RECIPIENTS					
		Technical/Advisory	Grants	Loans	Direct Payments/Contracts	Watershed Control	In-lake Control	Engineering/Construction	Lake/Reservoir Usage	Education	Planning	Individuals	Nonprofit Organizations	Profit Organizations	Special Purpose Government Units	State Government Units	Local Government Units
DEPARTMENT OF AGRICULTURE	Water Bank Program	X	X														
	Rural Clean Water Program	X	X														
	Agricultural Conservation Program (ACCP)		X														
	FARMERS HOME ADMINISTRATION																
	Farm Ownership Loans		X														
	Irrigation, Drainage and Other Soil and Water Conservation Loans		X														
	Recreation Facility Loans		X														
	Resource Conservation and Development Loans		X														
	Soil and Water Loans		X														
	Water and Waste Disposal Systems for Rural Communities		X														
DEPARTMENT OF COMMERCE	Watershed Protection and Flood Prevention Loans		X														
	Business and Industrial Loans		X														
	Area Development Assistance Planning Grants		X														
	FOREST SERVICE																
	Forestry Research		X														
	Cooperative Forestry Assistance		X														
	Grants to States — Titles I, II, III, IV, and IX		X														
	Projects		X														
	Economic Development — Public Works and Development Facilities		X														
	Economic Development — Public Works Impact Projects		X														
DEPARTMENT OF ECONOMIC DEVELOPMENT	Economic Development — Public Works and Development Facilities		X														
	Economic Development — Public Works Impact Projects		X														
	Grants to States — Titles I, II, III, IV, and IX		X														
	Projects		X														
	Economic Development — Public Works and Development Facilities		X														
	Economic Development — Public Works Impact Projects		X														
	Grants to States — Titles I, II, III, IV, and IX		X														
	Projects		X														
	Economic Development — Public Works and Development Facilities		X														
	Economic Development — Public Works Impact Projects		X														
DEPARTMENT OF AGRICULTURE	Water Bank Program	X	X														
	Rural Clean Water Program	X	X														
	Agricultural Conservation Program (ACCP)		X														
	FARMERS HOME ADMINISTRATION																
	Farm Ownership Loans		X														
	Irrigation, Drainage and Other Soil and Water Conservation Loans		X														
	Recreation Facility Loans		X														
	Resource Conservation and Development Loans		X														
	Soil and Water Loans		X														
	Water and Waste Disposal Systems for Rural Communities		X														
DEPARTMENT OF COMMERCE	Watershed Protection and Flood Prevention Loans		X														
	Business and Industrial Loans		X														
	Area Development Assistance Planning Grants		X														
	FOREST SERVICE																
	Forestry Research		X														
	Cooperative Forestry Assistance		X														
	Grants to States — Titles I, II, III, IV, and IX		X														
	Projects		X														
	Economic Development — Public Works and Development Facilities		X														
	Economic Development — Public Works Impact Projects		X														
DEPARTMENT OF ECONOMIC DEVELOPMENT	Economic Development — Public Works and Development Facilities		X														
	Economic Development — Public Works Impact Projects		X														
	Grants to States — Titles I, II, III, IV, and IX		X														
	Projects		X														
	Economic Development — Public Works and Development Facilities		X														
	Economic Development — Public Works Impact Projects		X														
	Grants to States — Titles I, II, III, IV, and IX		X														
	Projects		X														
	Economic Development — Public Works and Development Facilities		X														
	Economic Development — Public Works Impact Projects		X														

X = Research

P = Projects

* = Technical Information

Table 11-2
Summary of Federal, State and Regional Programs (Continued)

DEPARTMENT AGENCY PROGRAM NAME	TYPE OF ASSISTANCE										ELIGIBLE PROJECTS										ELIGIBLE RECIPIENTS									
	Technical/Advisory	Grants	Loans	Direct Payments/Contracts	Watershed Control	In-lake Control	Engineering/Construction	Leak/Spill Response	Education	Planning	Individuals	Nonprofit Organizations	Profit Organizations	Special Purpose Government Units	State Government Units	Local Government Units														
DEPARTMENT OF EDUCATION OFFICE OF EDUCATION Environmental Education		X							X					X																
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT COMMUNITY PLANNING AND DEVELOPMENT Comprehensive Planning Assistance (CPI)														X																
Community Development Block Grants		X												X																
Community Development Block Grants/Small Cities Program		X												X																
DEPARTMENT OF THE INTERIOR OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT Regulation of Coal Mining														X																
HERITAGE CONSERVATION AND RECREATION SERVICE Land and Water Conservation Fund Grants		X												X																
Urban Park and Recreation Recovery Program		X												X																
WATER AND POWER RESOURCES SERVICE Small Reclamation Projects		X												X																
U.S. FISH AND WILDLIFE SERVICE Fish Restoration Grants Barramundi Program		X												X																
Wildlife Restoration Program		X												X																
DEPARTMENT OF TRANSPORTATION COAST GUARD Pollution by Oil and Hazardous Substances -- Liability														X																
SMALL BUSINESS ADMINISTRATION Water Pollution Control Loans (WPC)		X												X																
Regulatory Loans (REGOL)		X												X																
Business Pollution Control Financing Guarantee		X												X																
WATER RESOURCES COUNCIL Water Resources Planning (17 CFR 80)		X												X																
ENVIRONMENTAL PROTECTION AGENCY OFFICE OF WATER AND WASTE MANAGEMENT Construction Grants for Wastewater Treatment Works														X																
Water Pollution Control -- State and Interstate Program Grants		X												X																
Water Pollution Control -- State and Interstate Water Quality Management Planning Agency		X												X																

10 - Federal assistance
11 - State and local assistance
12 - Private and non-profit assistance

17 - Federal assistance

18 - State assistance

19 - Local assistance

Table 11-2
Summary of Federal, State and Regional Programs (Continued)

DEPARTMENT AGENCY PROGRAM NAME	TYPE OF ASSISTANCE				ELIGIBLE PROJECTS							ELIGIBLE RECIPIENTS				
	Technical Advisory	Grants	Loans	Direct Payments/Contracts	Watershed Control	In-lake Control	Engineering/Construction	Lab/Laboratory Usage	Planning	Individuals	Nonprofit Organizations	Special Purpose Government Units	State Government Units	Local Government Units		
State Underground Water Source Protection Program Grants	X			X									X			
Solid and Hazardous Waste Management Program Support Grants	X													X		
Solid Waste Management Demonstration Grants	X					X						X	X			
OFFICE OF RESEARCH AND DEVELOPMENT Environmental Protection — Consolidated Research Grants	X	X		X					X	X	X	X	X			
Solid Waste Disposal Research Grants	X			X					X	X	X	X	X			
Water Pollution Control Research, Development and Demonstration Grants	X			X					X	X	X	X	X			
OFFICE OF PLANNING AND MANAGEMENT Loan Guarantees for Construction of Treatment Works		X	X	X											X	X
DEPARTMENT AGENCY PROGRAM NAME																
APPALACHIAN REGIONAL COMMISSION	X	X		X	X	X	X	X	X	X			X	X		
COASTAL PLAINS REGIONAL COMMISSION	X	X		X	X	X	X	X	X	X			X	X		
FOUR CORNERS REGIONAL COMMISSION	X	X		X	X	X	X	X	X	X			X	X		
NEW ENGLAND REGIONAL COMMISSION	X	X		X	X	X	X	X	X	X			X	X		
OLD WEST REGIONAL COMMISSION	X	X		X	X	X	X	X	X	X			X	X		
OZARKS REGIONAL COMMISSION	X	X		X	X	X	X	X	X	X			X	X		
PACIFIC NORTHWEST REGIONAL COMMISSION	X	X		X	X	X	X	X	X	X			X	X		
SOUTHWEST BORDER REGIONAL COMMISSION	X	X		X	X	X	X	X	X	X			X	X		
UPPER GREAT LAKES REGIONAL COMMISSION	X	X		X	X	X	X	X	X	X			X	X		

X = Research

Table 11-2
Summary of Federal, State and Regional Programs (Continued)

STATE/LOCAL PROGRAMS		STATE PROVIDED ASSISTANCE		ELIGIBLE PROJECTS							ELIGIBLE RECIPIENTS						
STATE DEPARTMENT PROGRAM NAME		Technical/Advisory	Grants	Loans	Watershed Control	In-lake Control	Engineering/Construction	Lake/Lakeshore Usage	Education	Planning	Individuals	Nonprofit Organizations	Special Purpose Gov't Units	State Government Units	Local Government Units		
STATE OF ALABAMA STATE PUBLIC HEALTH DEPARTMENT 314 Clean Lakes Program			F		X	X	X	X	X				X	X	X		
STATE OF ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION 314 Clean Lakes Program			X	F	X	X	X	X	X	X			X	X	X		
DEPARTMENT OF NATURAL RESOURCES Outdoor Recreation, Open Space and Historic Preservation Development Fund			X	X			X	X	X				X	X			
STATE OF ARIZONA DEPARTMENT OF HEALTH SERVICES 314 Clean Lakes Program			X	F	X	X	X	X	X				X	X	X		
ARIZONA OUTDOOR RECREATION COORDINATING COMMISSION State Lake Improvement Fund			X	*			X						X	X	X		
STATE OF ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY 314 Clean Lakes Program			X	F	X	X	X	X	X				X	X	X		
DEPARTMENT OF LOCAL SERVICES Local Government Water, Sewer and Solid Waste Management Systems Revolving Fund			X	X	X	X	X	X	X				X				
SOIL AND WATER CONSERVATION COMMISSION Arkansas Water Development Fund			X	*			X						X	X	X		
STATE DEPARTMENT PROGRAM NAME		Technical/Advisory	Grants	Loans	Watershed Control	In-lake Control	Engineering/Construction	Lake/Lakeshore Usage	Education	Planning	Individuals	Nonprofit Organizations	Special Purpose Gov't Units	State Government Units	Local Government Units		
GAME AND FISH COMMISSION Matching Federal Funds		X	X				X						X				
STATE OF CALIFORNIA WATER RESOURCES CONTROL BOARD 314 Clean Lakes Program		X	F		X	X	X	X	X	X			X	X	X		
Clean Water and Water Conservation Bond Law of 1978		X	**	X											X		
Pollution Cleanup and Abatement Account		C		X									X				
Sites Closure and Maintenance Revolving Account		C		X									X				
DEPARTMENT OF WATER RESOURCES AND CALIFORNIA RECLAMATION BOARD State Aid Program: Federal Flood Control Projects		X	X	X	X	X		X						X			
POLLUTION CONTROL FINANCING AUTHORITY Pollution Control Financing Authority Loan Program			X	X						X		X					
WILDLIFE CONSERVATION BOARD Recreation and Fish and Wildlife Enhancement Bond 1980 Bond Act		X						X	X				X	X			
DEPARTMENT OF PARKS AND RECREATION Robert-Z'berg Urban Open Space and Recreation Program			X					X					X	X			
STATE OF COLORADO DEPARTMENT OF HEALTH 314 Clean Lakes Program		X	F		X	X	X	X	X	X				X	X		

* = 314 Program match

F = Federal dollars

** = 314 Program match possible

C = Contra

F = Federal dollars

** = 314 Program match possible

C = Contract

F = Federal dollars

Table 11-2
Summary of Federal, State and Regional Programs (Continued)

STATE DEPARTMENT PROGRAM NAME	STATE PROVIDED ASSISTANCE				ELIGIBLE PROJECTS						ELIGIBLE RECIPIENTS				
	Technical/Advisory	Grants	Loans	Watershed Control	In-lake Control	Engineering/Construction	Lake/Lakeshore Usage	Education	Planning	Individuals	Nonprofit Organizations	Special Purpose Gov't Units	State Government Units	Local Government Units	
STATE OF ALABAMA SOIL CONSERVATION BOARD	X				X				X			X	X	X	
STATE OF ALABAMA DEPARTMENT OF ENVIRONMENTAL PROTECTION															
Lakes Management Program	X	*		X	X	X	X	X	X			X	X	X	
Weed and Algae Control Program	X	C		X								X	X	X	
Wildlife Refuges, Fish Spawning Areas and Refuges	X					X						X	X	X	
STATE OF ALABAMA DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL															
314 Clean Lakes Program	X	F		X	X	X	X	X	X			X	X	X	
STATE OF ALABAMA DEPARTMENT OF ENVIRONMENTAL REGULATION															
Water Resources Restoration and Preservation Program	X	*		X	X	X	X	X	X			X	X	X	
Pollution Control Measures and Devices (Bond Program)	X	X		X	X	X						X	X	X	
STATE OF ALABAMA DEPARTMENT OF NATURAL RESOURCES															
Florida Recreation Development Assistance Program	X	X				X						X	X	X	
Florida Boating Improvement Fund	X	X				X									
STATE OF ALABAMA DEPARTMENT OF NATURAL RESOURCES															
314 Clean Lakes Program	X	F		X	X	X	X	X	X			X	X	X	
Economic and Environmental Grant Program	X	X		X	X	X	X	X	X			X	X	X	
* = 314 Program match															
C = Cost Reimbursement															
F = Federal dollars															
Emergency Grant Program	X	X		X								X	X	X	
Georgia Heritage Trust Program	X	X		X								X	X	X	
STATE OF ALABAMA DEPARTMENT OF HEALTH AND WELFARE															
314 Clean Lakes Program	X	F		X	X	X	X	X	X			X	X	X	
DEPARTMENT OF WATER RESOURCES															
Water Resources Loans and Grants Program	X	X		X	X	X						X	X	X	
DEPARTMENT OF PARKS AND RECREATION															
Idaho Waterways Improvement Fund	X	X			X										
Technical Assistance	X														
STATE OF ALABAMA ENVIRONMENTAL PROTECTION AGENCY															
Lakes Program, Planning Section	X	F		X	X	X	X	X	X			X	X	X	
DEPARTMENT OF TRANSPORTATION															
Division of Water Resources	X			X	X	X	X	X	X			X	X	X	
STATE OF ALABAMA STATE BOARD OF HEALTH															
314 Clean Lakes Program	X	F		X	X	X	X	X	X			X	X	X	
STATE OF ALABAMA DEPARTMENT OF ENVIRONMENTAL QUALITY															
314 Clean Lakes Program	X	F		X	X	X	X	X	X			X	X	X	
F = Federal dollars															

Table 11-2
Summary of Federal, State and Regional Programs (Continued)

\$ = Federal dollars

Table 11-2
Summary of Federal, State and Regional Programs (Continued)

STATE DEPARTMENT PROGRAM NAME	STATE PROVIDED ASSISTANCE				ELIGIBLE PROJECTS				ELIGIBLE RECIPIENTS					
	Technical/Advisory	Grants	Loans	Watershed Control	In-lake Control	Engineering/Construction	Lake/Lakeshore Usage	Education	Planning	Individuals	Nonprofit Organizations	Special Purpose Gov't Units	State Government Units	Local Government Units
STATE OF NEBRASKA														
DEPARTMENT OF ENVIRONMENTAL CONTROL														
314 Clean Lakes Program		X		X	X	X	X	X	X			X	X	X
DEPARTMENT OF NATURAL RESOURCES														
Natural Resources Development Fund		X	*	X	X	X	X	X	X			X	X	X
Water Conservation Fund		X	X	X	X					X				
GAME AND PARKS COMMISSION														
Land and Water Conservation Funds		X		X	X	X	X	X	X			X	X	X
STATE OF NEVADA														
DEPARTMENT OF CONSERVATION & NATURAL RESOURCES														
314 Clean Lakes Program		X	P	X	X	X	X	X	X	X	X	X	X	X
Reforestation Assistance		X		X	X	X	X	X	X			X	X	X
State Bonds Program		X	X	X	X	X	X	X	X			X	X	X
STATE OF NEW HAMPSHIRE														
WATER SUPPLY AND POLLUTION CONTROL COMMISSION														
Lakes Management Program		X	F	X	X	X	X	X	X	T	T	X	X	X
STATE OF NEW JERSEY														
DEPARTMENT OF ENVIRONMENTAL PROTECTION														
Lakes Management Program		X	*					X				X	X	X
Green Acres Land Acquisition and Recreation Opportunities Program		X	*	X	X	X	X	X	X			X	X	X
Aid for Urban Environmental Concerns		X	X		X	X	X	X	X			X	X	X

STATE DEPARTMENT PROGRAM NAME	STATE PROVIDED ASSISTANCE				ELIGIBLE PROJECTS				ELIGIBLE RECIPIENTS					
	Technical/Advisory	Grants	Loans	Watershed Control	In-lake Control	Engineering/Construction	Lake/Lakeshore Usage	Education	Planning	Individuals	Nonprofit Organizations	Special Purpose Gov't Units	State Government Units	Local Government Units
STATE OF NEW MEXICO														
DEPARTMENT OF HEALTH AND ENVIRONMENT														
314 Clean Lakes Program		X	F	X	X	X	X	X	X			X	X	X
DEPARTMENT OF NATURAL RESOURCES														
Land and Water Conservation Fund		X		X	X	X	X	X	X			X	X	X
INTERSTATE STREAM COMMISSION														
Water Research, Conservation and Development Fund		X	X	X	X	X	X	X	X	X		X	X	X
STATE OF NEW YORK														
DEPARTMENT OF ENVIRONMENTAL CONSERVATION														
314 Clean Lakes Program		X	F	X	X	X	X	X	X	X		X	X	X
State Aid for Comprehensive Study		X	X					X						X
STATE OF NORTH CAROLINA														
DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT														
Grants for Water Resource Development Projects		X	*	X	X	X	X	X	X			X	X	X
County Allocation Fund		X	X	X	X									X
SOIL AND WATER CONSERVATION COMMISSION														
Grants for Small Watershed Projects		X	X	X	X	X	X	X	X					
COUNTY COMMISSIONERS														
Erosion Control Equipment		P		X	X	X	X	X	X	X				

* = 314 Program match
F = Federal dollar
P = Property
T = Technical assistance only

P = Property
T = Technical assistance only

* = 314 Program match
F = Federal Dollars

F = Federal dollar

* = 314 Program match

P = Property

STATE DEPARTMENT PROGRAM NAME	STATE PROVIDED ASSISTANCE		ELIGIBLE PROJECTS						ELIGIBLE RECIPIENTS				
	Grants	Loans	Watershed Control	In-lake Control	Engineering/Construction	Lake/Lakeshore Usage	Education	Planning	Individuals	Nonprofit Organizations	Special Purpose Gov't Units	State Government Units	Local Government Units
STATE OF SOUTH CAROLINA													
DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL													
314 Clean Lakes Program	X	F		X	X	X	X	X			X	X	X
STATE OF SOUTH DAKOTA													
DEPARTMENT OF WATER AND NATURAL RESOURCES													
State Lakes Protection and Rehabilitation Grants	X	*		X	X	X	X	X			X	X	X
STATE OF TENNESSEE													
DEPARTMENT OF PUBLIC HEALTH													
314 Clean Lakes Program	X	F		X	X	X	X	X			X	X	X
STATE OF TEXAS													
DEPARTMENT OF WATER RESOURCES													
314 Clean Lakes Program	X	F		X	X	X	X	X			X	X	X
DEPARTMENT OF PARKS AND WILDLIFE													
Local Parks and Recreation and Open Space Program	X	X			X	X	X	X			X	X	X
STATE OF UTAH													
DEPARTMENT OF HEALTH													
314 Clean Lakes Program	X	F		X	X	X	X	X			X	X	X
DEPARTMENT OF COMMUNITY AFFAIRS													
Community Impact Fund	X	X									X	X	X

* = 314 Program match
* = Federal dollars

STATE DEPARTMENT PROGRAM NAME	STATE PROVIDED ASSISTANCE		ELIGIBLE PROJECTS						ELIGIBLE RECIPIENTS				
	Grants	Loans	Watershed Control	In-lake Control	Engineering/Construction	Lake/Lakeshore Usage	Education	Planning	Individuals	Nonprofit Organizations	Special Purpose Gov't Units	State Government Units	Local Government Units
STATE OF VERMONT													
AGENCY OF ENVIRONMENTAL CONSERVATION													
DEPARTMENT OF WATER RESOURCES													
Lakes and Ponds Program				X	X								
Aquatic Nuisance Control Program	X	X		X							X	X	X
DEPARTMENT OF FOREST, PARKS AND RECREATION													
State Matching Funds	X	X											
STATE OF VIRGINIA													
STATE WATER CONTROL BOARD													
314 Clean Lakes Program	X	F		X	X	X	X				X	X	X
COMMISSION OF OUTDOOR RECREATION													
Virginia Outdoors Fund	X	C			X	X	X				X	X	X
Recreation Services Section	X												
STATE OF WASHINGTON													
DEPARTMENT OF ECOLOGY: WATER POLLUTION CONTROL AGENCY													
Lake Restoration Program (Referendum 26 Funds)	X	X		X	X	X	X				X	X	X
State Grant Program (Referendum 36 Funds)	X	**		X	X	X	X				X	X	X
INTERAGENCY COMMITTEE FOR OUTDOOR RECREATION													
Recreation Grants-in-Aid	X	X				X					X	X	X
PARK AND RECREATION COMMISSION													
Parks and Recreation Consultation	X										X	X	X

* = 314 Program match
** = 314 Program match possible
C = Cost Reimbursement
F = Federal dollars

Table 11-2
Summary of Federal, State and Regional Programs (Continued)

11.2 Combination With Other Complementary Efforts

In addition to providing direct matching funds, other programs at the Federal, regional, and State levels can be coordinated with Clean Lakes projects by providing funds for activities that are not directly a part of the work funded under section 314. These are also summarized in Table 11-2. As an example, the Clean Lakes Program regulations specifically exclude costs for controlling point source discharges, where the sources can be alleviated by permits issued under either section 402 of the Clean Water Act, or by the planning and construction of wastewater treatment facilities under section 201 of the Act. Nevertheless, it is recognized that such control of point source discharges is extremely important in the lake restoration process, and that where possible, this work should be coordinated with Clean Lakes projects. Thus, while references to section 201 programs are not included in the State program sections of the matrix, it is important to check with the appropriate program office to determine their applicability to Clean Lakes restoration.

Other examples are recreational facilities development programs, such as the Land and Water Conservation Program under the Department of the Interior's Heritage Conservation and Recreation Service. They may not be used to provide matching funds to a Clean Lakes project, but activities funded under them can greatly enhance the benefits obtainable with Clean Lakes funds. Again, as with 201, no reference appears in the matrix to these LAWCON programs.

Department of Agriculture programs, especially in the Agricultural Stabilization and Conservation Service, the Farmers Home Administration, and the Soil Conservation Service, are other examples of funded programs which may be used with the Clean Lakes Program. It is important to remember that applications for Clean Lakes projects proposing coordination with other complementary activities will receive more favorable consideration for funding by EPA.

11.3 Sources of Additional Information

Written descriptions of Federal, regional, and State programs can be found in Appendix H to this manual. The Federal programs are divided

into three sections: those providing financial assistance; those providing technical, informational, or advisory services; and those providing labor. Programs providing financial assistance to be coordinated with the Clean Lakes Program have been summarized in the matrices in this chapter. The matrices indicate the department, agency, and program identification; type of assistance; type of projects which are eligible for the funds; and the eligible recipients. This information, along with the total obligations for fiscal year 1980, average project size, and various application information, has been obtained from the Catalog of Federal Domestic Assistance (available in major libraries, or may be purchased from the Superintendent of Documents, U.S. Government Printing Office). Where necessary, the matrices have been supplemented by data obtained directly from program managers.

Two other Federal programs are not included in the matrix but may be useful. The U.S. Army Corps of Engineers has a program which is primarily research-oriented, dealing with projects such as aquatic plant control, beach erosion control, flood control, debris clearance, and channel straightening. This assistance is usually in the form of technical consulting and research by Corps personnel.

The other Federal program which does not appear in the matrix is the General Services Administration's Disposal of Federal Surplus Real and Personal Property Programs. This program provides for the transfer of property such as abandoned military installations from the Federal government to eligible recipients. The transfer is usually on a specialized basis and depends on the location of the proposed project.

Information concerning State and regional programs was obtained from interviews with State and regional officials. These programs are described in Appendix H, and presented in the matrices in this section.

State program descriptions in this manual are not as complete as those at the Federal level because organizing and identifying activities at the State level is more difficult. Where possible, information concerning Federal programs which can be matched with State programs is given in the matrix along with an indication of the maximum amount of State funds which can be provided.

12.0 HYPOTHETICAL LAKE PROJECTS

This section presents two hypothetical examples that illustrate typical procedures and activities involved in applying for and performing both Phase 1 and Phase 2 projects. They have been developed to illustrate the use of material presented elsewhere in this manual (specifically, Section 8.0 — Phase 1 Studies; Section 9.0 — Phase 2 Programs; and Section 11.0 — Technical and Financial Assistance Programs).

- Example 1 — A Phase 1 diagnostic-feasibility study of an Oregon lake which requires a complete Phase 1 monitoring program. Both watershed management and in-lake restoration programs to protect and restore the lake are described.
- Example 2 — A Phase 2 implementation program for a relatively large rural lake in Wisconsin, requiring both watershed management and in-lake restoration activities to restore and protect the lake.

Although hypothetical, these examples are based on real experiences. The technical and financial assistance programs described are actual programs.

12.1 Example 1 — Phase 1 Diagnostic-Feasibility Study

12.1.1 Introduction

This hypothetical project illustrates a typical Phase 1 diagnostic-feasibility study that includes lake and watershed monitoring over a period of 1 year. The study illustrates how lake problems lead to the design and implementation of a Phase 1 study, consisting of:

1. Development of a detailed Phase 1 work plan
2. Study of lake and watershed characteristics
3. Study of social, economic, and recreational characteristics of the lake and watershed
4. Lake monitoring
5. Watershed monitoring

6. Data analysis
7. Development and evaluation of alternatives
8. Selection and development of watershed management and lake restoration programs
9. Projection of benefits
10. Environmental evaluation
11. Public participation
12. Preparation of reports.

12.1.2 Historical Background

Lake James, located in Brown County, Ore., is a multipurpose man-made lake which provides recreation (boating, fishing, camping, and swimming) for the citizens of Brown County and the City of Francis. It is also used as the primary potable water supply for these areas. Half of the population uses Lake James for water supply, while the other half uses private wells.

In 1968, algal blooms appeared in late summer and early fall. During these periods occasional taste and odor problems occurred in the drinking water, resulting in frequent citizen complaints. In 1969 a small fish kill occurred in the lake near the dam; personnel from the Brown County Water and Sewer Authority investigated the fish kill and decided that low dissolved oxygen conditions were the probable cause.

Although Authority personnel tested water withdrawn daily from the lake for turbidity, color, and several other parameters related to water treatment, neither they, nor the Brown County Soil and Water Conservation District, had ever collected quantitative and definitive data on the trophic condition or nutrient loading of the lake. In response to continued and increasing citizen concern over the allegedly deteriorating condition of the lake, the Conservation District, Brown County Water and Sewer Authority, and the City of Francis approached the State of Oregon about submitting an application for a Phase 1 diagnostic-feasibility study.

12.1.3 Phase 1 Application

At the request of the Oregon Department of Environmental Quality, the three agencies developed a draft Phase 1 application based on EPA regulations published in the *Federal Register* (40 CFR Part 35 Subpart H — see Appendix B of this manual); the application was prepared on OMB Standard Form 424 (EPA Form 5700-33). The required program narrative provided the information listed in Table 12-1 (see Table 8-2 in Section 8.0 for a detailed outline).

The application also contained an introductory chapter that presented an overview of the lake, its location, problems, proposed activities, and project participants.

Table 12-1
Phase 1 Outline

Lake description
Watershed description
Public access, benefits, and recreational use
Pollutant sources and existing control practices
Scope of proposed project
Project schedule
Project budget

The cost estimate prepared by the Conservation District, Authority, and City indicated they would need \$131,000 to perform a sufficiently comprehensive study. Oregon DEQ's Clean Lakes Program budget had been fully obligated to other lake projects. However, the three agencies who had initiated the request for the study did not want to wait until the next fiscal year to begin work. Consequently, they provided the matching amount to the State as shown in Table 12-3.

The draft application was reviewed by the State of Oregon; the DEQ staff, in turn, informally discussed it with the Clean Lakes coordinator in the EPA Region X Office. Authority, Conservation District, and City personnel met with State and Region X EPA personnel several times to discuss and modify the Phase 1 application.

The final application was prepared by the State, which added the priority ranking of the project and their certification that the project was consistent with the State Water Quality Management Work Plan, the approved 208 Water Quality Management Plan, and the State Comprehensive Outdoor Recreation Plan. The State then submitted the application to EPA Region X, with recommended approval and forwarded the application to EPA Headquarters for its review. Headquarters concurred with the Region, and Region X issued an offer of award to the State. After notifying EPA of its decision to accept the award, Oregon DEQ signed a substate agreement with the Brown County Soil and Wa-

ter Conservation District, the agency which would administer the project.

Table 12-2
Characteristics of Lake James

Location: Brown County, Ore.	
Lake Characteristics:	
Surface Area	162 ha
Volume	$5.4 \times 10^6 \text{ m}^3$
Mean Depth	3.4 m
Maximum Depth	6.8 m
Stratified	Yes
Lake Problems:	
Algal Blooms of <i>Anabaena</i> sp.	
Depressed Oxygen Conditions	
Taste and Odor Problems	
Watershed Characteristics:	
Drainage Area	620 km ²
Tributaries	4 major streams
Mean Flow Through Lake	380 cfs (10 m ³ /sec.)
Land Use:	
Forest	40%
Wetlands	5%
Open/Transitional	8%
Developed	8%
Pastureland	27%
Cropland	12%
Point Sources:	
Municipal (entering through tributaries)	3
Industrial	2
Public Access and Use:	
Public Access Areas	4
Uses	Boating, Fishing, Camping, Swim- ming, Potable Wa- ter Supply

12.1.4 Project Activities

The Phase 1 study was designed to obtain data on the trophic condition of Lake James, to define the sources and magnitude of the nutrient and sediment loadings to the lake, to evaluate the need for reductions in these loadings and the expected response of the lake, to evaluate the need for in-lake restoration, and to develop a watershed and lake management program.

Table 12-3
Lake James Phase 1 Funding Sources

U.S. EPA Cooperative Agreement	\$ 91,700
Brown County Conservation District	21,000
Brown County Water and Sewer Authority	4,300
City of Francis	14,000
Phase 1 Total	\$131,000

12.1.4.1 Consultant Selection Since neither the District, Authority, nor City personnel were experienced in limnology and watershed management, they decided to retain a consultant to assist them in developing the detailed work plan and conducting the study. The District followed the procurement guidelines provided in the *Federal Register* (40 CFR Part 33—Subagreements) entitled "Minimum Standards for Procurement Under EPA Grants." These guidelines follow those published by the Office of Management and Budget (OMB) in OMB Circular A-102. Of the three methods of procurement (small purchase procedure, formal advertising, and negotiation), they decided to use negotiation. They mailed requests for qualifications to 10 firms, reviewed the qualifications and interviewed three firms. They asked each firm to indicate its specific experience in the following areas:

1. Physical, chemical, and biological lake studies
2. Nonpoint source studies, including setting up automated monitoring stations and stream gaging stations
3. Analyzing the trophic condition of lakes
4. Analyzing wet and dry weather data to calculate a reliable annual nutrient and sediment loading budget
5. Evaluating best management practices and in-lake restoration techniques
6. Analyzing institutional approaches for implementation of proposed management and in-lake restoration activities
7. Assisting in public participation activities
8. Knowledge of, and experience with, the EPA Clean Lakes Program.

They selected a consultant who demonstrated experience in all of these areas. The consultant's first task was to assist in preparing a final detailed work plan.

12.1.4.2 Lake Monitoring Because of the lake's long, narrow shape, three sampling stations were located on it. After the EPA project officer approved the monitoring program, monitoring was initiated. Samples were collected monthly from September through April and bi-weekly from May through August. Because the lake experiences stratification, several depths were sampled at each station. These sampling depths were located at 1/2 meter below the surface, 1/2 meter above the bottom, and at one or two intermediate points, depending on depth.

This type of sampling was done to define any vertical variations in water quality.

During each sampling period, water samples were collected at each sampling depth for chemical analyses. Water quality parameters which were measured in the field included pH, conductivity, Secchi disk reading, temperature, and dissolved oxygen (using a combination temperature—DO probe). Water samples collected from the 1/2 meter depth were also analyzed for chlorophyll *a* and algal genera.

12.1.4.3 Stream Monitoring. Stream gaging stations were installed on the two major tributaries to the lake and at the lake's outlet. These three stations were selected because they accounted for nearly 90 percent of the flow into Lake James. Also, wet weather conditions could be monitored manually due to the relatively large size of the streams. During select storm events, flow-composited water samples were collected and sent to the laboratory for chemical analysis.

Dry weather stream samples were collected monthly and analyzed for the same parameters as the wet weather samples.

12.1.4.4 Land Use Monitoring. Stormwater runoff was monitored from several land uses (residential, cropland, and pastureland) to determine the relative magnitude and form of nutrient loadings. A flow recorder (bubbler type) and automatic water sampler used to monitor stormwater runoff from each land use were programmed to collect samples for incremental changes in flow.

12.1.4.5 Miscellaneous Monitoring. Sediment samples were collected from the lake bottom at the three lake stations and analyzed for organic and nutrient content. Water samples were also collected from selected wells in the watershed.

A bathymetric survey was performed by dividing the lake into 300 meter segments, using a surveying crew to install stakes on both sides of the lake to guide a boat equipped with a high-accuracy depth meter (with printout).

12.1.4.6 Data Analysis. Lake, watershed, land use, and other associated data were analyzed to determine the present trophic condition and the sources of nutrients entering the lake.

The annual phosphorus loading to Lake

James, presented in Table 12-4, indicates that nonpoint sources account for 72 percent of the loading and one point source (ABC Foods Co.) accounts for 21 percent of the loading. Although both Doe River and Lesser Creek have about the same drainage area, the phosphorus loading from Doe River is significantly higher, indicating that the phosphorus export per unit of land area is much higher for Doe River. Review of the land use data indicated that Doe River has more intense land use than Lesser Creek:

Land Use	Doe River	Lesser Creek
Undeveloped	40%	75%
Pasture	20%	18%
Cropland	20%	6%
Developed	20%	1%

Analysis of the watershed and land use monitoring data showed that developed land has the greatest phosphorus loading rate:

Land Use	Phosphorus Loading (lb/ac/yr)
Developed	1.4
Agriculture	0.3
Undeveloped	0.2

Table 12-4
Lake James Annual Phosphorus Loading

	Source	% of Total
A.	<u>Tributaries (Nonpoint Source)</u>	
	Doe River	36
	Lesser Creek	27
	Minor Tributaries and Immediate Drainage	9
B.	<u>Municipal STP's</u>	
	Towson	1
	Anderson School	1
	Midway	1.5
C.	<u>Industrial</u>	
	ABC Food Co.	21
	Midway Machine Co.	1
D.	<u>Septic Tanks</u>	2
E.	<u>Direct Precipitation</u>	0.5
		100.0

High N/P ratios indicated that phosphorus was consistently the limiting nutrient. This agreed with past algal assays performed by the EPA as part of the National Eutrophication Study.

Application of the Vollenweider-Dillon empirical phosphorus loading model to the lake indicated that the lake is eutrophic and that the annual phosphorus loading would have to be reduced to significantly improve water quality.

12.1.4.7 *Management Plan Development.* Results of the study indicated that both lake and

watershed management would be needed to restore the lake and protect it from further degradation.

Because of the large size of the watershed, implementation of management practices will be a continuous process and will take many years. Therefore, the management plan includes lake treatment, water plant treatment, and watershed management. The plan includes the following activities:

1. Upgrade existing water treatment plant to add activated carbon for taste and odor control (not funded by 314).
2. Install compressed air aeration system in lake near the dam and water intake.
3. Implement agricultural best management practices through existing local, State, and Federal programs (e.g., ASCS-ACP Program and other options discussed in Section 11.0).
4. Implement roadway and highway best management practices in cooperation with the State highway department.
5. Enforce existing construction erosion control ordinance.
6. Develop and implement a runoff control ordinance for all new developments.
7. Develop and implement an environmental education program.
8. Install innovative nonpoint source controls for developing areas.
9. Reduce phosphorus discharge of the ABC Food Co. (not funded by 314).

At the completion of the study, a final report was prepared, organized according to the information requirements in Appendix A to the regulations (40 CFR 35 Subpart H). Because it thus included not only the study findings but also the proposed Phase 2 monitoring program, funding sources, work plan, the results of public participation, and the environmental assessment, it could be directly incorporated into a Phase 2 application. This would reduce the cost and time needed to apply for implementation funding and would expedite review of the application.

The Authority and City decided to seek State and Federal funding to implement the plan. A Phase 2 implementation application will be submitted to obtain matching funds to install: (1) an aeration system, (2) agricultural best management practices, (3) roadway best management practices to control erosion and runoff, (4) special best management practices in the Doe River subbasin (the major source of phosphorus loading to the lake); and to develop an environmental education program.

12.1.5 Financial Considerations

The Phase 1 budget, presented in Table 12-5, indicates that the Conservation District provided

in-kind services for constructing and installing three stream stations (two inlets and one outlet) and for engineering and administrative services. The Water and Sewer Authority provided additional engineering services and field assistance in water sampling and land use data collection. The City provided laboratory facilities and a lab technician; however, \$10,700 worth of laboratory equipment had to be purchased to perform all

the lab tests. The City also contributed in-kind services of technical staff and a citizens advisory group who provided technical overview of the project.

Consulting services, obtained by the Conservation District and paid for with EPA funds, totaled \$60,100. The remainder of the cooperative agreement moneys were used to purchase equipment and supplies.

Table 12-5
Lake James Phase I Budget

A. In-Kind Services:

1. Brown County Soil and Water Conservation District:

Construction and installation of three stream gaging stations	\$ 18,000	
Engineering — 40 hrs. @ \$25.00	1,000	
Administration — 80 hrs. @ \$25.00	<u>2,000</u>	
Total District		21,000

2. Brown County Water and Sewer Authority

Field Assistance (labor) — 200 hrs. @ \$15.00	3,000	
Engineering — 52 hrs. @ \$25.00	<u>1,300</u>	
Total Authority		4,300

3. City of Francis

Laboratory services (based on personnel time and hourly cost)	13,000	
In-kind labor of citizens on technical review committee — 40 hrs. @ \$25.00	<u>1,000</u>	
Total City		<u>14,000</u>

Total In-Kind Services \$39,300

B. Consultant:

Develop detailed work plan	\$ 1,000	
Study lake and watershed characteristics	4,000	
Perform land use analysis	3,000	
Monitor lake water quality and biology	10,000	
Monitor dry and wet weather stream flow water quality	8,000	
Monitor stormwater runoff from land uses	5,000	
Monitor sediments	2,000	
Monitor groundwater quality	3,000	
Analyze lake and watershed data	7,000	
Define and evaluate watershed management alternatives, prepare environmental assessment, and recommend plan of action	6,000	
Prepare final report presenting study results and management alternatives	9,000	
Assist in public participation activities	<u>2,000</u>	
Total Consultant		\$60,000

C. Equipment and Supplies

Recording flow meters for gaging stations (three)	\$15,000	
Recording flow meter for land use monitoring	2,000	
Automatic water sampler	2,000	
Laboratory equipment	10,700	
Field and laboratory supplies	<u>2,000</u>	
Total Equipment		<u>\$31,700</u>

Phase I Total

\$131,000

12.2 Example 2 — Phase 2 Implementation Program

Johnson Lake is a heavily used recreational lake in Wisconsin. On summer weekends, the lake attracts fishermen, sailors, and swimmers. Water-skiing and diving are also popular. While the general water quality of Johnson Lake was good, it was threatened by agricultural runoff, septic tank seepage, and municipal and commercial wastewater discharges. Late summer blooms of blue-green algae were common recently, and problems with aquatic weeds were experienced near the shore. The lake users and the Office of Inland Lake Renewal in the Wisconsin Department of Natural Resources were concerned about deterioration of the water quality of the lake and decided that steps should be taken to protect and enhance Johnson Lake.

To that end, the local lake users and the DNR undertook a restoration and protection project. The Johnson Lake Public Inland Lake Protection and Rehabilitation District was formed under provisions of Chapter 33 of the Wisconsin Statutes. The local district was formed by the persons within the Johnson Lake watershed directly affected by its condition and willing to help solve the problems.

The lake district was formed with the aid of University of Wisconsin-Extension specialists who provided information on the formation and operation of lake districts. The Wisconsin State legislature has mandated the Extension to provide educational leadership for the lake management program. Chapter 33 also provided for a partnership between the lake district and the DNR in which the Office of Inland Lake Renewal provided technical and financial assistance to lake management plans.

Subsequently, a Phase I Diagnostic-Feasibility Study was conducted on Johnson Lake and its watershed. The study focused on estimating hydraulic and nutrient budgets for the lake, measuring existing lake water quality, and identifying major water quality problems. The results of that study are summarized in Table 12-6.

Based on the study results, the DNR Office of Inland Lake Renewal concluded that nutrient influx from the watershed was causing excessive and undesirable growth of algae and rooted aquatic vegetation. It was also determined that phosphorus was the limiting plant nutrient.

The DNR report suggested that a comprehensive lake restoration and protection project be undertaken to improve and preserve the water quality of Johnson Lake. The plan was to limit nutrient influx and sedimentation and to treat specific in-lake problems (weeds and hypolimnetic oxygen depletion). Additionally, water pollution abatement projects to address the problem of upstream point sources of pollution were recommended.

The nutrient budget calculations performed as part of the diagnostic-feasibility study indicated that the major phosphorus sources to Johnson Lake were agricultural runoff (30 percent), wastewater treatment plants (35 percent), and malfunctioning septic systems (10 percent). It was estimated that the contribution from nonpoint agricultural runoff could be halved through best management practices. An additional 10 percent could be eliminated by upgrading faulty septic treatment systems. Improving existing wastewater treatment plants upstream of Johnson Lake could reduce phosphorus loading by 20 percent. An overall 45 percent reduction in phosphorus would, it was calculated, significantly improve lake water quality.

On behalf of the Johnson Lake Protection and Rehabilitation District, the Wisconsin DNR applied to the U.S. EPA for matching funds to conduct a Phase 2 Lake Restoration Project. The project design stressed curbing the influx of phosphorus from the watershed, supplemented by in-lake remedial measures. An important management proposal was to contain barnyard manure from the watershed's numerous dairy farms during the winter to prevent it from run-

Table 12-6
Characteristics of Johnson Lake

Lake Characteristics	
Surface area	384 hectares
Volume	40 x 10 ⁶ m ³
Mean depth	10 m
Maximum depth	15 m
Stratified	Yes
Lake Problems:	
Late summer blooms of blue-green algae	
Aquatic weed growth	
Hypolimnetic oxygen depletion	
Watershed Characteristics:	
Drainage area	570 km ²
Tributaries	2 major streams 3 minor streams
Land Use:	
Forest	35%
Wetland	10%
Open/Transitional	5%
Developed	15%
Pastureland	25%
Cropland	10%
Point Sources of Water Pollution:	
Municipal	1
Other WWTP's	2
Other Nonpoint Sources of Water Pollution:	
Private septic tanks (cottages and resorts)	Multiple
Public Access and Use:	
Public access areas	1
Uses	Boating, Fishing, Camping, Swimming, Resort Area

ning into the lake with snowmelt from still frozen fields in the spring.

The application to conduct a Section 314 Clean Lakes project requested 50 percent Federal matching funds for a project costing \$666,667. The Wisconsin State legislature had provided \$2 million for the biennium with the provision that no grant exceed 10 percent of available State funds. Therefore, \$200,000 of State money was available, and a local contribution of \$133,333 was required. The local contribution was raised by taxing all taxable property within the district at a rate of 2.5 mills of assessed valuation, the maximum rate provided for in Chapter 33 to carry out lake projects. Equalized assessed valuation of taxable property within the district totaled approximately \$54 million. The 2.5 mill rate, therefore, just allowed for financing this project and annual operating expenses of the lake district. Region V of EPA approved the application and awarded a cooperative agreement to Wisconsin.

One of the lake district's first actions was to purchase about 40 hectares of land to develop grass waterways and buffer strips. This was funded as part of the Section 314 project. The grass buffer strips would absorb much of the phosphorus contained in the runoff water before it reached Johnson Lake. A system of check dams was also constructed in areas prone to rapid runoff and consequent erosion to prevent sediment from reaching the lake.

Also contributing to sediment infilling of Johnson Lake was a localized problem associated with streambank erosion in one of the tributaries, Silver Creek. Gradual accumulation of sand, silt, and detritus at the mouth of the creek had formed a delta. A streambank stabilization program was instituted to reduce that erosion and sediment transport. Areas of severe streambank erosion were rippedraped or sloped, seeded, and mulched to stabilize the banks.

In-lake treatment measures for Johnson Lake included hypolimnetic aeration and localized dredging. Aeration was performed during the late summer periods when the deep waters became anoxic. Increased oxygen concentrations in the hypolimnion of Johnson Lake would reduce nutrient release from sediments and improve fish habitat.

Shallow weed beds in areas of extensive recreational use were excavated to a depth at which most rooted aquatic plants were not expected to grow. Because the dredging was localized in near-shore areas, conventional earthmoving equipment could be used, reducing cost and spoil disposal problems.

The Johnson Lake watershed had an approved 208 agricultural nonpoint sources plan and qualified for financial assistance to cost-share installation of best management practices. Decisions were made by the Soil Conservation Ser-

vice, the local Soil and Water Conservation District, Wisconsin Extension, and the area Regional Planning Commission, identifying the best systems for individual farms. In cooperation with the individual farmers involved, applications were submitted by the local Soil and Water Conservation District for Agricultural Stabilization and Conservation Service (ASCS) money to build manure storage facilities through the Agricultural Conservation Project program.

The manure storage facilities were cost-shared under provisions of a pooling agreement between ASCS, State of Wisconsin, Johnson Lake District, and the individual farmers. Six storage facilities were built for a total cost of \$72,000. The ASCS fund would cover 75 percent of the cost of the storage structures to a maximum of \$3,500 each and the Wisconsin Fund contributed up to an additional \$4,000 per project, with the total grant (ACP + Wisconsin Fund) being no greater than 70 percent of the total project cost. The Wisconsin Fund cost-shared the purchase of transfer equipment (pumps, pipelines, etc.) as well as the basic storage pit, items not eligible for cost-sharing through ASCS. The remainder of the cost of the manure storage facilities was shared equally by the Johnson Lake district and the individual farmers.

Recreational access to Johnson Lake was deemed to be insufficient and a new park that included a boat launching facility was established. A 2-1/2 hectare parcel of land was acquired for \$20,000. That purchase, not eligible for 314 funding, was made through the Federal Land and Water Conservation Program of the Heritage Conservation and Recreation Service, the Wisconsin Outdoor Recreation Action Program, and a 25 percent local match. Associated boat launching facilities within the new park were funded through the Wisconsin Boating Recreation Program. A boat ramp and parking area for eight combination car-trailer units cost an additional \$10,000 and was cost-shared 50:50 by State and local participants.

Many of the cottages that ring Johnson Lake were found to have failing septic tank systems that contributed to the phosphorus load of the lake. The failure of those systems was caused by overloading and progressive clogging of the infiltrative surfaces of the soil absorption systems. Cost-effectiveness analyses of the various alternatives for small wastewater treatment systems showed that small diameter gravity sewer collection of septic tank effluent with soil absorption disposal was the best solution to the septic tank problem.

Groundwater was determined to flow through the lake from north to south. Therefore, the septic tanks serving cottages on the north shore of the lake were connected to a collection system that conveyed the effluent to a single large absorption field west of the lake. This project was

conducted in cooperation with the County zoning administrator and sanitarian who checked the adequacy of each septic tank before it was hooked up to the collection system.

The cost of this project was financed by the lake district through the U.S. EPA Section 201 Grants Program for construction of treatment works. The project qualified as an innovative treatment technique and, as such, was eligible for 85 percent Federal cost-sharing. The 15 percent local contribution was raised by issuing

general obligation bonds that mature after a period of 5 years at an interest rate of 8 percent per annum.

In a rural area upstream of Johnson Lake, a cheese factory discharged whey wastes into a nearby ditch, eventually reaching a stream leading to Johnson Lake. At the urging of the Johnson Lake District and the Wisconsin DNR, the cheese factory operators applied for and received a guaranteed/insured loan through the Farmers Home Administration, Business and In-

Table 12-7
Financing for Johnson Lake Projects^a

I. Section 314 PROJECT BUDGET		
<i>Breakdown of Tasks:</i>		
Hypolimnetic aeration	\$220,563	
Dredging	123,582	
Stream bank stabilization (rip-rapping, sloping, mulching, seeding) and erosion control (acquisition and development of grass waterways and buffer strips)	<u>322,522</u>	
<i>Total</i>		\$666,667
<i>Financial Breakdown:</i>		
Johnson Lake Protection and Rehabilitation District	\$133,333	
Wisconsin Department of Natural Resources	200,000	
U.S. Environmental Protection Agency	<u>333,334</u>	
<i>Total</i>		\$666,667
II. MANURE STORAGE FACILITIES		
<i>Financial breakdown:</i>		<i>Total</i>
ASCS/ACP	\$ 21,000	\$ 72,000
Wisconsin Funds	24,000	
Johnson Lake District	13,500	
Farmer landowner	<u>13,500</u>	
<i>Total</i>		\$ 72,000
III. RECREATIONAL ACCESS DEVELOPMENT		
<i>Project Elements:</i>		
Park land acquisition — 10 acres @ \$2,000/acre	\$ 20,000	
Boat ramp installation and associated parking facilities	<u>10,000</u>	
<i>Total</i>		\$ 30,000
<i>Financial Breakdown:</i>		
Federal Heritage Conservation and Recreation Service program	\$ 10,000	
Wisconsin Outdoor Recreation Action program	5,000	
Wisconsin Boating Recreation program	<u>10,000</u>	
<i>Total</i>		\$ 30,000
IV. SEPTIC TANK IMPROVEMENTS WITH EFFLUENT DIVERSION AND TREATMENT		
<i>Financial Breakdown:</i>		<i>Total</i>
U.S. Environmental Protection Agency (Sec. 201)	\$294,100	\$346,000
Johnson Lake District	25,950	
Cottage landowners	<u>25,950</u>	
<i>Total</i>		\$346,000
V. CHEESE FACTORY SPRINKLER IRRIGATION DISPOSAL SYSTEM		
Guaranteed/insured loan to cheese factory operators for \$50,000 from FmHA through Business and Industrial Loans Program.		
VII. KNAUERVILLE WWTP IMPROVEMENTS		
<i>Financial Breakdown:</i>		<i>Total</i>
Wisconsin Fund	\$1,632,000	\$2,720,000
City of Kнауerville	<u>1,088,000</u>	
<i>Total</i>		\$2,720,000

^a Including Section 314 rehabilitation and protection project and allied water pollution abatement projects.

dustrial Loans Program. With that money, the cheese factory installed a spray irrigation system to dispose of wastes on adjacent land. Hay was harvested off that land and sold for cattle feed. The loan made to the cheese factory was \$50,000. No State or lake district funds were involved in this project.

The final phase of the Johnson Lake project involved upgrading the wastewater treatment plant of the City of Knauerville, upstream of Johnson Lake on Silver Creek. That phase of the project replaced the existing raw sewage stabilization pond discharging to the creek with an activated sludge treatment system followed by sand filtration, chlorination, and disposal by infiltration-percolation.

The project was carried out with Wisconsin Fund moneys, since the priority of the Knauerville project was too low, according to the State's ranking system to qualify for Federal Section 201 funds. The Municipal Construction Grants Program of the Wisconsin Fund provided 60 percent of the project cost. The local share of the project cost was borne by the City of Knauerville and financed through the sale of municipal revenue bonds to be paid back by a property tax. Total cost of improvements to the Knauerville WWTP was \$2.72 million. The municipality share was \$1.088 million. A summary of the financing for the Johnson Lakes projects is in Table 12-7.

Appendix A

GLOSSARY OF LAKE AND WATERSHED MANAGEMENT TERMS

Aeration: A process in which water is treated with air or other gases, usually oxygen. In lake restoration, aeration is used to prevent anaerobic condition or to provide artificial destratification.

Algal bloom: A high concentration of a specific algal species in a water body, usually caused by nutrient enrichment.

Algicide: A chemical highly toxic to algae.

Alkalinity: A quantitative measure of water's capacity to neutralize acids. Alkalinity results from the presence of bicarbonates, carbonates, hydroxides, salts, and occasionally of borates, silicates, and phosphates. Numerically, it is expressed as the concentration of calcium carbonate that has an equivalent capacity to neutralize strong acids.

Allochthonous: Describes organic matter produced outside of a specific stream or lake system.

Alluvial: Pertaining to sediments gradually deposited by moving water.

Artificial destratification: The process of inducing water currents in a lake to produce partial or total vertical circulation.

Artificial recharge: The addition of water to the groundwater reservoir by activities of man, such as irrigation or induced infiltration.

Assimilation: The absorption and conversion of nutritive elements into protoplasm.

Autochthon: Any organic matter indigenous to a specific stream or lake.

Autotrophic: The ability to synthesize organic matter from inorganic substances.

Background loading of concentration: The concentration of a chemical constituent arising from natural sources.

Base flow: Stream discharge due to ground-water flow.

Benthic oxygen demand: Oxygen demand exerted from the bottom of a stream or lake, usually by biochemical oxidation of organic material in the sediments.

Benthos: Organisms living on or in the bottom of a body of water.

Best management practices: Practices, either structural or non-structural, which are used to control nonpoint source pollution.

Bioassay: The use of living organisms to determine the biological effect of some substance, factor, or condition.

Biochemical oxidation: The process by which bacteria and other microorganisms break down organic material and remove organic matter from solution.

Biochemical oxygen demand (BOD), biological oxygen demand: The amount of oxygen used by aerobic organisms to decompose organic material. Provides an indirect measure of the concentration of biologically degradable material present in water or wastewater.

Biological control: A method of controlling pest organisms by introduced or naturally occurring predatory organisms, sterilization, inhibiting hormones, or other nonmechanical or non-chemical means.

Biological magnification, biomagnification: An increase in concentration of a substance along succeeding steps in a food chain.

Biomass: The total mass of living organisms in a particular volume or area.

Biota: All living matter in a particular region.

Blue-green algae: The phylum Cyanophyta, characterized by the presence of blue pigment in addition to green chlorophyll.

Catch basin: A collection chamber usually built at the curb line of a street, designed to admit surface water to a sewer or subdrain and to retain matter that would block the sewer.

Catchment: Surface drainage area.

Chemical control: A method of controlling pest organisms through exposure to specific toxic chemicals.

Chlorophyll: Green pigment in plants and algae necessary for photosynthesis.

Circulation period: The interval of time in which the thermal stratification of a lake is destroyed, resulting in the mixing of the entire water body.

Coagulation: The aggregation of colloidal particles, often induced by chemicals such as lime or alum.

Coliform bacteria: Nonpathogenic organisms considered a good indicator of pathogenic bacterial pollution.

Colorimetry: The technique used to infer the concentration of a dissolved substance in solution by comparison of its color intensity with that of a solution of known concentration.

Combined sewer: A sewer receiving both stormwater runoff and sewage.

Compensation point: The depth of water at which oxygen production by photosynthesis and respiration by plants and animals are at equilibrium due to light intensity.

Cover crop: A close-growing crop grown primarily for the purpose of protecting and improving soil between periods of permanent vegetation.

Crustacea: Aquatic animals with a rigid outer covering, jointed appendages, and gills.

Culture: A growth of microorganisms in an artificial medium.

Denitrification: Reduction of nitrates to nitrites or to elemental nitrogen by bacterial action.

Depression storage: Water retained in surface depressions when precipitation intensity is greater than infiltration capacity.

Design storm: A rainfall pattern of specified amount, intensity, duration, and frequency that is used as a basis for design.

Detention: Managing stormwater runoff or sewer flows through temporary holding and controlled release.

Detritus: Finely divided material of organic or inorganic origin.

Diatoms: Organisms belonging to the group Bacillariophyceae, characterized by the presence of silica in its cell walls.

Dilution: A lake restorative measure aimed at reducing nutrient levels within a water body by the replacement of nutrient-rich waters with nutrient-poor waters.

Discharge: A volume of fluid passing a point per unit time, commonly expressed as cubic meters per second.

Dissolved oxygen (DO): The quantity of oxygen present in water in a dissolved state, usually expressed as milligrams per liter of water, or as a percent of saturation at a specific temperature.

Dissolved solids (DS): The total amount of dissolved material, organic and inorganic, contained in water or wastes.

Diversion: A channel or berm constructed across or at the bottom of a slope for the purpose of intercepting surface runoff.

Drainage basin, watershed, drainage area: A geographical area where surface runoff from streams and other natural watercourses is carried by a single drainage system to a common outlet.

Dry weather flow: The combination of sanitary sewage and industrial and commercial wastes normally found in the sanitary sewers during the dry weather season of the year; or, flow in streams during dry seasons.

Dystrophic lakes: Brown-water lakes with a low lime content and a high humus content, often severely lacking nutrients.

Enrichment: The addition to or accumulation of plant nutrients in water.

Epilimnion: The upper, circulating layer of a thermally stratified lake.

Erosion: The process by which the soils of the earth's crust are worn away and carried from one place to another by weathering, corrosion, solution, and transportation.

Eutrophication: A natural enrichment process of a lake, which may be accelerated by man's activities. Usually manifested by one or more of the following characteristics: (a) excessive biomass accumulations of primary producers; (b) rapid organic and/or inorganic sedimentation and shallowing; or (c) seasonal and/or diurnal dissolved oxygen deficiencies.

Fecal streptococcus: A group of bacteria normally present in large numbers in the intestinal tracts of humans and other warm-blooded animals.

First flush: The first, and generally most polluted, portion of runoff generated by rainfall.

Flocculation: The process by which suspended

particles collide and combine into larger particles or flocules and settle out of solution.

Gabion: A rectangular or cylindrical wire mesh cage (a chicken wire basket) filled with rock and used to protect against erosion.

Gaging station: A selected section of a stream channel equipped with a gage, recorder, and/or other facilities for determining stream discharge.

Grassed waterway: A natural or constructed waterway covered with erosion-resistant grasses, used to conduct surface water from an area at a reduced flow rate.

Green algae: Algae characterized by the presence of photosynthetic pigments similar in color to those of the higher green plants.

Heavy metals: Metals of high specific gravity, including cadmium, chromium, cobalt, copper, lead, mercury. They are toxic to many organisms even in low concentrations.

Hydrograph: A continuous graph showing the properties of stream flow with respect to time.

Hydrologic cycle: The movement of water from the oceans to the atmosphere and back to the sea. Many subcycles exist including precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

Hypolimnion: The lower, non-circulating layer of a thermally stratified lake.

Intermittent stream: A stream or portion of a stream that flows only when replenished by frequent precipitation.

Irrigation return flow: Irrigation water which is not consumed in evaporation or plant growth, and which returns to a surface stream or groundwater reservoir.

Leaching: Removal of the more soluble materials from the soil by percolating waters.

Limiting nutrient: The substance that is limiting to biological growth due to its short supply with respect to other substances necessary for the growth of an organism.

Littoral: The region along the shore of a body of water.

Macrophytes: Large vascular, aquatic plants which are either rooted or floating.

Mesotrophic lake: A trophic condition between an oligotrophic and an eutrophic water body.

Metalimnion: The middle layer of a thermally stratified lake in which temperature rapidly decreases with depth.

Most probable number (MPN): A statistical indication of the number of bacteria present in a given volume (usually 100 ml).

Nannoplankton: Those organisms suspended in open water which because of their small size,

cannot be collected by nets (usually smaller than approximately 25 microns).

Nitrification: The biochemical oxidation process by which ammonia is changed first to nitrates and then to nitrites by bacterial action.

Nitrogen, available: Includes ammonium, nitrate ions, ammonia, and certain simple amines readily available for plant growth.

Nitrogen cycle: The sequence of biochemical changes in which atmospheric nitrogen is "fixed," then used by a living organism, liberated upon the death and decomposition of the organism, and reduced to its original state.

Nitrogen fixation: The biological process of removing elemental nitrogen from the atmosphere and incorporating it into organic compounds.

Nitrogen, organic: Nitrogen components of biological origin such as amino acids, proteins, and peptides.

Nonpoint source: Nonpoint source pollutants are not traceable to a discrete origin, but generally result from land runoff, precipitation, drainage, or seepage.

Nutrient, available: That portion of an element or compound that can be readily absorbed and assimilated by growing plants.

Nutrient budget: An analysis of the nutrients entering a lake, discharging from the lake, and accumulating in the lake (e.g., input minus output = accumulation).

Nutrient inactivation: The process of rendering nutrients inactive by one of three methods: (1) Changing the form of a nutrient to make it unavailable to plants, (2) removing the nutrient from the photic zone, or (3) preventing the release or recycling of potentially available nutrients within a lake.

Oligotrophic lake: A lake with a small supply of nutrients, and consequently a low level of primary production. Oligotrophic lakes are often characterized by a high level of species diversification.

Orthophosphate: See phosphorus, available.

Outfall: The point where wastewater or drainage discharges from a sewer to a receiving body of water.

Overturn, turnovers: The complete mixing of a previously thermally stratified lake. This occurs in the spring and fall when water temperatures in the lake are uniform.

Oxygen deficit: The difference between observed oxygen concentrations and the amount that would be present at 100 percent saturation at a specific temperature.

Peak discharge: The maximum instantaneous flow from a given storm condition at a specific location.

Percolation test: A test used to determine the rate of percolation or seepage of water through natural soils. The percolation rate is expressed as time in minutes for a 1-inch fall of water in a test hold and is used to determine the acceptability of a site for treatment of domestic wastes by a septic system.

Perennial stream: A stream that maintains water in its channel throughout the year.

Periphyton: Microorganisms that are attached to or growing on submerged surfaces in a waterway.

Phosphorus, available: Phosphorus which is readily available for plant growth. Usually in the form of soluble orthophosphates.

Phosphorus, total (TP): All of the phosphorus present in a sample regardless of form. Usually measured by the persulfate digestion procedure.

Photic zone: The upper layer in a lake where sufficient light is available for photosynthesis.

Photosynthesis: The process occurring in green plants in which light energy is used to convert inorganic compounds to carbohydrates. In this process, carbon dioxide is consumed and oxygen is released.

Phytoplankton: Plant microorganisms, such as algae, living unattached in the water.

Plankton: Unattached aquatic microorganisms which drift passively through water.

Point source: A discreet pollutant discharge such as a pipe, ditch, channel, or concentrated animal feeding operation.

Population equivalent: An expression of the amount of a given waste load in terms of the size of human population that would contribute the same amount of biochemical oxygen demand (BOD) per day. A common base is 0.17 pounds (7.72 grams) of 5-day BOD per capita per day.

Primary production: The production of organic matter from light energy and inorganic materials, by autotrophic organisms.

Protozoa: Unicellular animals, including the ciliates and nonchlorophyllous flagellates.

Rainfall intensity: The rate at which rain falls, usually expressed in centimeters per hour.

Rational method: A means of computing peak storm drainage runoff (Q) by use of the formula $Q = CIA$, where C is a coefficient describing the physical drainage area, I is the average rainfall intensity, and A is the size of the drainage area.

Raw water: A water supply which is available for use but which has not yet been treated or purified.

Recurrence interval: The anticipated period in years that will elapse, based on average probability of storms in the design region, before a storm of a given intensity and/or total volume

will recur; thus, a 10-year storm can be expected to occur on the average once every 10 years. Sewers are generally designed for a specific design storm frequency.

Riprap: Broken rock, cobbles, or boulders placed on earth surfaces, such as the face of a dam or the bank of a stream, for protection against the action of water (waves).

Saprophytic: Pertaining to those organisms that live on dead or decaying organic matter.

Scouring: The clearing and digging action of flowing water, especially the downward erosion caused by stream water in sweeping away mud and silt, usually during a flood.

Secchi depth: A measure of optical water clarity as determined by lowering a weighted Secchi disk into a water body to the point where it is no longer visible.

Sediment basin: A structure designed to slow the velocity of runoff water and facilitate the settling and retention of sediment and debris.

Sediment delivery ratio: The fraction of soil eroded from upland sources that reaches a continuous stream channel or storage reservoir.

Sediment discharge: The quantity of sediment, expressed as a dry weight or volume, transported through a stream cross-section in a given time. Sediment discharge consists of both suspended load and bedload.

Septic: A putrefactive condition produced by anaerobic decomposition of organic wastes, usually accompanied by production of malodorous gases.

Standing crop: The biomass present in a body of water at a particular time.

Sub-basin: A physical division of a larger basin, associated with one reach of the storm drainage system.

Substrate: The substance or base upon which an organism grows.

Suspended solids: Refers to the particulate matter in a sample, including the material that settles readily as well as the material that remains dispersed.

Swale: An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water. Swales conduct stormwater into primary drainage channels and provide some groundwater recharge.

Terrace: An embankment or combination of an embankment and channel built across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.

Thermal stratification: The layering of water bodies due to temperature-induced density differences.

Thermocline: See metalimnion.

Tile drainage: Land drainage by means of a series of tile lines laid at a specified depth and grade.

Total solids: The solids in water, sewage, or other liquids, including the dissolved, filterable, and nonfilterable solids. The residue left when a sample is evaporated and dried at a specified temperature.

Trace elements: Those elements which are needed in low concentrations for the growth of an organism.

Trophic condition: A relative description of a lake's biological productivity. The range of trophic conditions is characterized by the terms oligotrophic for the least biologically productive, to eutrophic for the most biologically productive.

Turbidity: A measure of the cloudiness of a liquid. Turbidity provides an indirect measure of the suspended solids concentration in water.

Urban runoff: Surface runoff from an urban drainage area.

Volatile solids: The quantity of solids in water, sewage, or other liquid, which is lost upon ignition at 600° C.

Waste load allocation: The assignment of target pollutant loads to point sources so as to achieve water quality standards in a stream segment in the most effective manner.

Water quality: A term used to describe the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Water quality standards: State-enforced standards describing the required physical and chemical properties of water according to its designated uses.

Watershed: See drainage basin.

Weir: Device for measuring or regulating the flow of water.

Zooplankton: Protozoa and other animal microorganisms living unattached in water.

Appendix B

CLEAN LAKES PROGRAM REGULATIONS

- (1) Cooperative Agreements for Protecting and Restoring Publicly Owned Freshwater Lakes (40 CFR 35 Subpart H, February 5, 1980).
- (2) Availability of Clean Lakes Grant Assistance (Federal Register, Vol. 43, No. 132, pp. 29617-8, July 10, 1978).

comments is appropriate. Comments with respect to cost limits for a given location should be sent to the address indicated above.

A Finding of Inapplicability respecting the National Environmental Policy Act of 1969, has been made in accordance with HUD procedures. A copy of this Finding of Inapplicability will be available for public inspection during regular business hours in the Office of the Rules Docket Clerk, Office of General Counsel, Room 5218, 451 7th Street, S.W., Washington, D.C. 20410.

Accordingly, the per unit cost schedules setting Prototype Cost Limits for Low-Income Housing are amended

as follows:

At 24 CFR Part 841, Appendix A, Prototype Cost Limits for Low-Income Public Housing, revise the per unit cost schedule for elevator dwellings, as shown on the prototype per unit cost schedule, Region X, Kennewick, Washington.

(Sec. 7(d), Department of HUD Act, 42 U.S.C. 3535(d); Sec. 8(b) U.S. Housing Act of 1937, 42 U.S.C. 1437(d))

Issued at Washington, D.C. on January 28, 1980.

Lawrence B. Simons,
Assistant Secretary for Housing-Federal
Housing Commissioner.

Region X

	Bedrooms					
	0	1	2	3	4	5
Kennewick, Wash:						
Detached and semidetached						
Flow dwellings						
Walkup						
Elevator structure	27,800	30,800	38,850			

(PR Doc. 80-3885 Filed 2-4-80; 8:45 am)

BILLING CODE 4210-01-M

DEPARTMENT OF DEFENSE

Department of the Army

35 CFR Part 253

Panama Canal Commission Personnel Matters

AGENCY: Secretary of the Army.

ACTION: Final rule.

SUMMARY: The Panama Canal Act of 1979, Pub. L. No. 96-70, 93 Stat. 452, creates two statutory positions in the Panama Canal Commission: A Chief Engineer and an Ombudsman. This rule excludes those positions and their principal assistants from the Merit System established pursuant to section 10 of an Act of July 25, 1956, Pub. L. No. 85-550, 72 Stat. 408 and continued under Title 2, Canal Zone Code, Section 140, 76A Stat. 18, and section 1214 of the Panama Canal Act of 1979. The rule will also exclude the positions from various other provisions of the employment system applicable to employment in Federal agencies in the Republic of Panama. Because this rule pertains to personnel matters of the Panama Canal Commission it is unnecessary to issue a notice of proposed rulemaking under Title 5, U.S.C., Section 553.

EFFECTIVE DATE: January 13, 1980.

ADDRESS: Department of the Army, Washington, D.C. 20310.

FOR FURTHER INFORMATION CONTACT: Colonel Michael Rhode, Jr., Office of the Assistant Secretary of the Army (CW), Washington, D.C. 20310; telephone (202) 695-1370.

Adoption of Amendment

Accordingly, effective January 13, 1980, 35 CFR 253.8(b) is amended by adding a new subparagraph (14) to read as follows:

§ 253.8 Exclusions.

• • • • •

(b) • • •

(14) The positions in the Panama Canal Commission of Ombudsman, Chief Engineer, Assistant to the Ombudsman, and Deputy Chief Engineer.

• • • • •

(Panama Canal Act of 1979, sec. 1212, 93 Stat. 452, 488; 35 CFR 251.2(a)(1))

Clifford L. Alexander, Jr.,

Secretary of the Army.

(PR Doc. 80-3881 Filed 2-4-80; 8:45 am)

BILLING CODE 3540-01-M

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 35

[FRL 1388-4]

Cooperative Agreements for Protecting and Restoring Publicly Owned Freshwater Lakes

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: This regulation establishes policies and procedures by which States may enter into cooperative agreements to assist in carrying out approved methods and procedures for restoring publicly owned freshwater lakes, and protecting them against degradation, as authorized by section 314 of the Clean Water Act (33 U.S.C. 1251 *et seq.*). This regulation was proposed on January 29, 1979 (44 FR 5685) for a sixty-day public comment period. EPA received 48 letters of comment which we have considered in developing this regulation.

EFFECTIVE DATE: This regulation governs only clean lakes cooperative agreements which are awarded after February 5, 1980. Cooperative agreements and grants that are awarded before February 5, 1980, will continue according to their original terms subject to the regulations under which the funds were awarded. Clean lakes applications received before February 5, 1980 will be processed according to past procedures.

ADDRESSES: Comments submitted on these regulations may be inspected at the Public Information Reference Unit, EPA Headquarters, Room 2922, Waterside Mall, 401 M Street, SW., Washington, D.C. 20460, between 8 a.m. and 4 p.m. on business days.

FOR FURTHER INFORMATION CONTACT: Joseph A. Krivak, Criteria and Standards Division (WH-685), Environmental Protection Agency, Washington, D.C. 20460. Telephone: (202) 755-0100.

SUPPLEMENTARY INFORMATION: This regulation contains the policies and procedures governing the provision of Federal financial assistance to States for the protection and restoration of publicly owned freshwater lakes as authorized by the Clean Water Act (33 U.S.C. 1251 *et seq.*) Section 314. The program is called the clean lakes program.

The Federal Grant and Cooperative Agreement Act requires all Federal Agencies to classify each assistance transaction as either a grant or a cooperative agreement. EPA will award grants when little Federal involvement

in the project is expected, and cooperative agreements when significant Federal involvement is anticipated. We expect significant EPA involvement in all Clean Lakes projects and have designated cooperative agreements as the appropriate award instrument.

Section 314 requires each State to prepare and submit a report to EPA including: (1) An identification and classification of all publicly owned freshwater lakes in that State according to eutrophic condition; (2) procedures, processes, and methods (including land use requirements) to control sources of pollution of these lakes; and (3) methods and procedures, in conjunction with appropriate Federal agencies, to restore the quality of these lakes. Section 314 also provides financial assistance to States to implement lake restoration and protection methods and procedures approved by the Administrator.

Pub. L. 95-217, amended section 314(b) of the Clean Water Act by adding the following: "The Administrator shall provide financial assistance to States to prepare the identification and classification surveys required in subsection (a)(1) of this section." On July 10, 1978, EPA published a notice of availability in the *Federal Register* for States to identify and classify their publicly owned freshwater lakes according to trophic condition, establish priority rankings for lakes in need of restoration; and conduct diagnostic-feasibility studies to determine methods and procedures to protect or restore the quality of those lakes (43 FR 29617). Total assistance of up to \$100,000 is available to each State for this lake classification survey. No award can exceed 70 percent of the eligible cost of the proposed project.

EPA carefully evaluated the performance of the clean lakes program during 1977 to determine how it might be improved. Based on this evaluation, we developed the revised procedures contained in this regulation. We published the proposed section 314 regulation, in the *Federal Register* (44 FR 5685) on January 29, 1979, for a sixty-day public comment period. In addition, we sent approximately 1000 copies of the proposed rule to the people identified on the current mailing list of the Environmental Resources Unit of the University of Wisconsin—Extension, to State agencies, environmental interest groups and specific requestors. The official comment period closed on March 30, 1979, and EPA has received 48 comment letters.

The following discussion responds to the comments received on the proposed regulation and is arranged in the order

of the sections of the regulation. Changes made in the final form of the regulation in response to public comment are discussed. Our responses to significant comments that did not lead to changes are also discussed.

Definitions

Freshwater lake

Some commenters believed that the definition of freshwater lake (§ 35.1605-2) should not include a limiting value for total dissolved solids (TDS). Section 314 allows funding only for publicly owned "freshwater" lakes. Since TDS is found in various scientific texts as a measure to distinguish freshwater from brackish water and saltwater, we believe it is relevant. We have selected a value of 1 percent TDS which is ten times the value used on page 306 in the *Water Encyclopedia*, Water Information Center, Inc., Port Washington, New York, 1970. We used the high value so that freshwater lakes that have received a high TDS loading a result of irrigation return flows and other land management practices (primarily in the far West) can be eligible.

Publicly owned freshwater lake

Several comments concerned the definition of "publicly owned freshwater lake" (§ 35.1605-3). We proposed that a publicly owned freshwater lake is, "[a] freshwater lake that offers public access to the lake through publicly owned contiguous lands so that any member of the public may have the same or equivalent opportunity to enjoy privileges and benefits of the lake as any other member of the public or as any resident around the lake." We understand that a lakeshore property owner stands to receive greater benefit from a lake than a day visitor. We have omitted reference to the lakeside resident, but we are still concerned about the potential for the clean lakes program providing benefits to the lakeshore property owner rather than the general public. However, since projects demonstrating the greatest public benefits will receive the highest priority under the review criteria in § 35.1640-1, we do not expect problems.

Other commenters questioned the appropriateness of requiring publicly owned contiguous land as the public access point. We believe the requirement is necessary to ensure that the public maintains unrestricted use of a lake after it is improved. Even so, in some cases where publicly owned contiguous land is not available, the lake may have substantial public use and benefit. One State indicated that by State statute all lakes greater than 10

acres surface area are in the public domain even if the shoreline is totally private. The State statute also guarantees that public access will be provided. In these cases EPA will require the State to define exactly where the public access points are, and to provide written agreements between the State and particular private property owners specifying the conditions and limitations of the public access. We will also require permanent signs to show the public access points and specify any lake use limitations. Similarly, States could negotiate long term leases or similar arrangements with private land owners, including private non-profits groups, to provide the necessary public access points. Again, we will require signs to indicate the limitations and extent of the public access. These arrangements would have to be completed before the award.

Eligibility

Some commenters suggested that section 314 cooperative agreements should continue to be awarded to local agencies. They contend that, otherwise, there will be a substantial erosion of the grassroots orientation of the program. We support the need to keep a grassroots thrust in the clean lakes program because of the voluntary nature of this assistance program. However, section 314 permits award of assistance only to States. Even so, since some States may not provide all the matching support required in clean lakes cooperative agreements, local agencies may provide the required remaining matching funds. We believe this funding partnership will preserve the grassroots nature of the program. We will work with the appropriate State agencies to assure that they minimize associated paperwork and "redtape," and provide clear concise guidance to local agencies. This will help to maintain the enthusiasm and involvement of local agencies.

EPA received several comments concerning the eligibility of Indian Tribes for section 314 funding. The commenters were concerned that, because Indian lands do not fall under the dominion of State Government, Tribal Governments may not be able to participate in this program. The statutory requirements of section 314 restricts award of assistance only to States. Section 35.1615 allows States to make financial arrangements with agencies located within the State including Indian Tribes to support lake restoration projects.

Some commenters objected to EPA's policy of not awarding assistance for lakes that are used only as drinking

water supplies. EPA has operated under this policy since the first awards under the clean lakes program in January 1976. We believe that the primary purpose of section 314 is to implement the goals of the Clean Water Act stated in section 101(a) as they relate to publicly owned freshwater lakes. Section 101(a)(2) states that, " * * * it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983." (emphasis added) The conference committee report of the 95th Congress, first session (House Report No. 95-830) made special note on page 94 in the comments of changes made to the Clean Water Act by the 1977 Amendments, that EPA should give special attention to restoring lakes which offer the potential for high utility as recreation areas. In keeping with the existing EPA policy and in support of the Congressional intent, we do not believe it is appropriate to allow funding of projects for lakes that are used only as drinking water supplies. Other funding sources are available to assist municipalities and States with protecting or improving drinking water supplies. Most communities accomplish this by assessing an appropriate water users fee under a regular billing procedure to support reservoir and processing plant operation and maintenance costs. Also, a portion of city and county taxes is likely to be used for such high priority community expenses.

Funding Levels

In the preamble of the proposed regulation, we requested comments on the proposed phasing of clean lakes cooperative agreements and the funding levels designated for each. The seventeen commenters who responded did not present persuasive arguments that the program would be more effective if the proposed matching requirements were reduced.

We continue to believe that the 50 percent matching requirement requires sufficient State/substate (non-Federal) commitment to assure the best project is implemented and proper maintenance of the project is continued after implementation is complete.

Lake Classification Requirement

A number of the comments concerned § 35.1630, requiring States to classify their publicly owned freshwater lakes in need of protection and restoration by January 1, 1982 in order to be eligible for funding support after that date under section 314. As explained in the

preamble of the proposed rule, this requirement does not mean that all of a State's publicly owned freshwater lakes must be surveyed, but a State must provide EPA with survey results of their priority lakes and the rationale for selecting the lakes surveyed. Other comments concerned EPA financial assistance to the States to perform the lake classification requirement. EPA will continue to award this cooperative agreement to States on a one-time-basis, under the July 10, 1978, *Federal Register* notice, until September 30, 1981. Approximately 20 States applied for this funding assistance. Most projects will be conducted over 18 months. We will restrict funding of this activity to a one-time award until all States electing to participate have initiated these efforts, and we have reviewed the overall program results.

Monitoring

A few commenters suggested the EPA should make available a third award phase for intensive monitoring of perhaps 10 percent of the implementation projects. The projects would be carefully selected to evaluate those lake restorative techniques that have little documentation on their capabilities and effectiveness. Although committed to strengthen the understanding of procedures to protect and restore the quality of the Nation's lakes, we continue to believe that some monitoring of each project during and after project implementation will provide us with a better review of program effectiveness than intensive monitoring in a few projects. However, we are encouraging EPA's Office of Research and Development to conduct a greater number of intensive investigations of lake protection and restoration techniques under the 104(h) authority of the Clean Water Act. We believe this approach will be responsive to both the program needs and the intent of the legislation.

Application and Priority

Several commenters asked how many Phase 1 and Phase 2 project applications an individual State could submit for funding consideration. The regulation does not specify a number. However, all applications must receive a State priority and we will consider the State priority placed on an application along with the other criteria presented in § 35.1640-1 when developing funding recommendations. We do foresee instances where, after considering all of these factors, a State may receive more than one of each type of cooperative agreement.

A significant number of comments were received on the required content of Phase 1 project applications. Most of these comments indicated that the information required is excessive and costly to assemble or obtain. As discussed in the preamble of the proposed rule, we believe that this information should be readily available to States and local agencies. No study or water quality monitoring is necessary to obtain the information since only the presentation of existing information is required. Furthermore, the information required in Phase 1 applications is precisely the information that participating States are required to assemble under their lake classification surveys conducted under the July 10, 1978, *Federal Register* notice.

We have reduced the mandatory information required in Phase 1 applications in response to those comments. Although not mandatory, § 35.1620-2(b) still includes a list of information that EPA believes should be in a Phase 1 application to allow EPA to effectively evaluate project applications and make funding decisions. Applications describing a proposed project in more complete terms may receive higher rating when evaluated according to the review criteria in § 35.1640-1.

EPA received four comments on the State requirement to set priorities on Phase 1 and Phase 2 projects as stated in § 35.1620-5. The commenters were concerned principally with the State capability to foresee specific projects 12 to 18 months in advance in sufficient detail to allow them to apply realistic funding priorities. We understand the problems associated with these procedures and realized that projects and associated priorities set more than a year in advance are subject to change. In § 35.1620-5 we have allowed States to alter project priority lists with a minimum of State effort. We need the information contained on State priority lists to determine program needs. We also need it to provide a basis for adjusting our workforce to match the identified workload.

Allotment

In the preamble of the proposed regulation we request comments regarding the allocation of clean lakes program appropriations to assure an equitable distribution of funds among the States. We received 6 comments on this issue; 4 supporting the status quo, one supporting the specification in the regulation of an annual deadline for application submission, and the other suggesting that an allocation of appropriations be made directly to the

States, although no formula was proposed. EPA's Office of General Counsel (OGC) and Grants Administration Division (GAD) suggested that a Regional allocation formula be considered as a means of providing equitable funding distribution. Despite the relatively small amount of program appropriations, we believe an allocation procedure has considerable merit. The advantages include: Regional flexibility in the negotiations with States for lake restoration projects, and better Regional capability to forecast workloads and develop appropriate manpower plans for annual budget submissions. Considering the advantages mentioned above, EPA will provide each Regional office a resource target from the section 314 appropriation based on State's identification of clean lakes work in the State WQM work programs. The State identification will consist of a two year forecasting of clean lakes applications, with funding needs, as part of the annual work program. The summation of these forecasts, coupled with the Congressional appropriation, will permit EPA to provide equitable resource targets. Regional offices will use these targets to negotiate projects within each State.

Targetting, based upon two year forecasting in work programs, will take effect in fiscal year 1982. For fiscal year 1981, EPA will target resources based on State-supplied information in existing State/EPA agreements, WQM work programs, and from the WQM Needs Survey.

Review Criteria

We have changed the application review criteria presented under § 35.1640-1 to reflect several comments. We have added a criterion to emphasize the importance of improving fish and wildlife habitat, and improving the populations of fish species.

A few commenters questioned the applicability of application review criteria § 35.1640-1(a)(4)(ii-iv). We believe that these criteria should be considered by States to judge the cost of a project in relation to public benefits derived, e.g., the more persons using a restored or protected lake the greater the benefits from the expenditure of public funds. Further, persons with low incomes cannot travel easily to lakes for recreational purposes unless the lakes are close to have sufficient public transportation to them. Such factors should be considered in the decision making process. This component is not intended to preclude lakes in rural settings from receiving financial

assistance under the clean lakes program.

The project award procedures under § 35.1650 have been changed. All EPA funding decisions will be made in the EPA Regional office by officials designated by the Regional Administrator. Program guidance and technical assistance will be supplied by EPA Headquarters, and all project applications will receive Headquarters review and technical recommendations.

Limitations on Award

Most comments on § 35.1650-2 were editorial and only minor changes in the language of this section have been made. Specific comments questioned the exclusion of aquatic plant harvesting as a lake restoration procedure. Section 35.1650-2(b)(5) does not exclude aquatic plant harvesting from supportable lake restoration programs. However, we believe that aquatic plant harvesting is only a temporary restorative measure in cases where pollution control measures are not implemented in the watershed to the greatest practicable extent. Even in cases where such pollution controls are in place, nutrient loading to the lake may be so great that harvesting aquatic vegetation may be required regularly to allow use of the lake. We will not generally consider a project for aquatic plant harvesting unless it will result in long lasting improvements.

A few commenters were confused regarding the relationship between 208 State and areawide wastewater management planning and the eligibility of a State to receive section 314 support. Section 208 planning does not have to be approved for a State to receive clean lakes assistance. If a 208 plan has been approved, the pertinent and applicable pollution controls identified in the 208 plan must be included in a clean lakes implementation plan. If a 208 plan has not been approved but has been developed, the pertinent and applicable pollution controls identified in the 208 plan should be included in the clean lakes project. If there is no 208 planning, then the lake protection and restoration procedures developed under a section 314 project should be consistent with 208 planning procedures so that the lake restoration planning can be included in any future 208 planning activities for the particular lake area.

In order to assure that these procedures are followed, States must certify under § 35.1620-2(a), that a project is consistent with the State Water Quality Management work program (see § 35.1513). Under § 35.1620-2(b), Phase 1 applications shall include written certification from the appropriate areawide or State 208

planning agency that work conducted under the proposed project will not duplicate work completed under any 208 planning grant, and that the applicant proposes to use any applicable approved 208 planning in the clean lakes project design. Under § 35.1620-2(c), Phase 2 applications must contain written certification from appropriate areawide or State 208 planning agencies that the proposed Phase 2 lake restoration proposal is consistent with any approved 208 planning.

One commenter suggested that 314 funding should be restricted so that it is not used to enhance boating or onshore recreational opportunities. EPA did not include these restrictions in the regulations for a variety of reasons. Lakes are traditionally used as recreational sites by the general public, and the degradation of those recreational sites through water pollution prompted the Congress to include section 314 in the Clean Water Act. EPA is supportive of the multiple use concept in the use of public funds. Frequently, the heavy use of the immediate lake shore will promote excessive pollutant loading, e.g., sediment and plant nutrients. In some cases, outright purchase of these lands to provide buffer strips is the most effective method of pollution control. Often lake shores can be used for low intensity recreational activities. Similarly, land abutting the lake may be purchased to provide an area to build a lake treatment structure and these areas should be considered for recreational opportunities.

Since recreational opportunities and water quality can sometimes be improved by removal of accumulated lake sediments, it would be inappropriate for EPA to ban dredging as an element of a comprehensive lake restoration project solely because it would benefit recreational activities.

As a means to assure that adverse environmental impact mitigation procedures are implemented in a lake restoration project, we have removed the 20 percent restriction on the cost of mitigation activities. All necessary mitigation activities should be included in the project. If mitigation costs are excessive, then the public benefits, when evaluated against project costs, will be lower and a proposed project will have lower priority for funding.

Conditions on Award

Numerous commenters were concerned about payment of the non-Federal share of a project by the State. We have modified § 35.1650-3(a)(2) to allow a State to arrange financing through substate financial agreements.

We understand that in many instances local agencies will be providing some or all of the required non-Federal matching share for clean lakes projects. It should be noted that as the only eligible award recipient, the State assumes the ultimate responsibility for the non-Federal share.

Some commenters argued that the monitoring program required under Appendix A (b)(3) is defined too rigidly. We agree, so we have modified the regulation to allow States and project officers to negotiate a program that is appropriate for each project.

Most commenters on the award conditions believe the requirement that States must maintain a project for ten years after a project is completed is excessive. We believe that States should agree to an operation and maintenance program that would assure that effective pollution controls are maintained to maximize the benefits in relation to the cost of the project. We believe that 10 years is a reasonable amount of time. Because we have no data to defend the cost effectiveness of this condition, it has been modified to cover only the project period. We believe the commitment by a State to an effective operation and maintenance program in the post project period is important and should be given special consideration in the evaluation of project proposals. Therefore, the evaluation criteria have been modified in § 35.1640-1 to include an assessment of the adequateness of the proposed post project operation and maintenance program.

We have changed section 35.1650-3(b) to allow Phase 1 recipients to negotiate with the project officer the project scope of work that is stated in section (a)(10) of Appendix A. Many commenters argued that the information required by section (a)(10) should be determined on a case by case basis. We believe that flexibility is desirable and will minimize project costs without sacrificing program integrity and public benefits. Similarly, we have modified § 35.1650-3(c) to allow flexibility on the design of Phase 2 monitoring programs to fulfill the requirement of section (b)(3) of Appendix A. Again, EPA project officer approval is required before the scope of work can be modified.

EPA received a significant number of comments on the reporting requirements in § 35.1650-5. The commenters were critical of the number of reports required and the amount of information required in Phase 1 project progress reports. Accordingly, we have modified the reporting requirements so that Phase 1 reports are only required semi-annually, and the final report will be the only Phase 1 report requiring the submission of water quality data. The frequency of

Phase 2 reporting will not exceed quarterly and will be based on the complexity of the project. The reporting requirement will be stipulated in the cooperative agreement.

Several commenters requested clarification of subsection (a)(7) of Appendix A. We believe that recipients and EPA should have sufficient information about the usability of other lakes in proximity to the project lake to evaluate the benefits in relation to the costs of a proposed project. The funds available to support lake protection and restoration activities are limited. Information required by subsection (a)(7) should be helpful to States in establishing priorities for projects. The regulations do not require States to conduct exhaustive surveys of lake resources within a 80 kilometer radius of the project lake, but we do need an understanding of similar lake use opportunities in that distance to assure appropriate use of public funds.

A few comments concerned the procedures used to determine the limiting nutrient in lakes. Section (a)(10) of Appendix A requires the calculation of total nitrogen to total phosphorus ratios and/or the use of the algal assay bottle tests. One commenter stated that the algal assay bottle test should be a required procedure. Although the bottle test is an excellent investigative procedure, we believe that many States lack the appropriate equipment to perform these analyses and the costs would be excessive in some cases. Other commenters suggested that other forms of nitrogen and phosphorus should be used to calculate the N/P ratio. We are aware of the significant controversy over the appropriateness and reproducibility of tests using other fractional chemical forms of these nutrients. EPA believes that at this time, the total nitrogen and total phosphorus ratio is the most desirable test. Appendix A calls for the measurement of several chemical forms of these nutrients. Investigators and EPA may wish to calculate other ratios in addition to total nitrogen to total phosphorus using these measurements.

Since the publication of the proposed rules, EPA's Administrator on June 14, 1979, signed a memorandum to assure that all environmental measurements done with EPA funding result in usable data of known quality. Any clean lakes cooperative agreements, awarded after OMB approves the Administrator's directive under the Federal Reports Act will contain a condition requiring compliance.

State/EPA Agreement

In these and other regulations, we are developing the concept of a State/EPA Agreement. The Agreement will provide a way for EPA Regional Administrators and States to coordinate a variety of programs under the Clean Water Act, the Resource Conservation and Recovery Act, the Safe Drinking Water Act and other laws administered by EPA. This subpart governs only that part of the State/EPA Agreement which relates to cooperative agreements under the clean lakes program. Other programs included in the State/EPA Agreement will be governed by provisions found elsewhere in this chapter. Beginning in FY 1980, State programs funded under section 314 of the Act will be part of the State/EPA Agreement and the State/EPA Agreement must be completed before grant award. EPA will issue guidance concerning the development and the content of the State/EPA Agreement.

Regulatory Analysis

We have determined that this regulation does not require regulatory analysis under Executive Order 12044.

Evaluation

Section 2(d)(8) of Executive Order 12044 requires that each regulation be accompanied by a plan for evaluating a regulation after it issued. In order to comply with this requirement, EPA will conduct an evaluation of this regulation which will either be presented in the section 304(j) report, which is scheduled to be published in December 1981, or published separately.

Dated: January 28, 1980.

Douglas M. Costle,
Administrator.

PART 35, SUBPART H ADDED

EPA is amending Title 40 of the Code of Federal Regulations by adding a new Subpart H to Part 35 to read as follows:

PART 35—STATE AND LOCAL ASSISTANCE

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Subpart H—Cooperative Agreements for Protecting and Restoring Publicly Owned Freshwater Lakes

- Sec.
35.1600 Purpose.
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- 35.1605-6 Trophic condition.
- 35.1605-7 Desalinization.
- 35.1605-8 Diagnostic-feasibility study.
- 35.1610 Eligibility.
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- 35.1620-5 State work programs and lake priority lists.
- 35.1620-6 State and local clearinghouse procedures.
- 35.1630 State lake classification surveys.
- 35.1640 Application review and evaluation.
- 35.1640-1 Application review criteria.
- 35.1650 Award.
- 35.1650-1 Project period.
- 35.1650-2 Limitations on awards.
- 35.1650-3 Conditions on awards.
- 35.1650-4 Payment.
- 35.1650-5 Allowable costs.
- 35.1650-6 Reports.
- Appendix A Requirements for diagnostic-feasibility studies and environmental evaluations.

Authority: Secs. 314 and 501, Clean Water Act (86 Stat. 818; 33 U.S.C. 1251 *et seq.*)

Subpart H—Cooperative Agreements For Protecting and Restoring Publicly Owned Freshwater Lakes

§ 35.1600 Purpose.

This subpart supplements the EPA general grant regulations and procedures (Part 30 of this chapter) and establishes policies and procedures for cooperative agreements to assist States in carrying out approved methods and procedures for restoration (including protection against degradation) of publicly owned freshwater lakes.

§ 35.1603 Summary of clean lakes assistance program.

(a) Under section 314 of the Clean Water Act, EPA may provide financial assistance to States to implement methods and procedures to protect and restore publicly owned freshwater lakes. Although cooperative agreements may be awarded only to States, these regulations allow States, through substate agreements, to delegate some or all of the required work to substate agencies.

(b) Only projects that deal with publicly owned freshwater lakes are eligible for assistance. The State must have assigned a priority to restore the lake, and the State must certify that the lake project is consistent with the State Water Quality Management Plan (§ 35.1521) developed under the State/EPA Agreement. The State/EPA Agreement is a mechanism for EPA Regional Administrators and States to coordinate a variety of programs under the Clean Water Act, the Resource

Conservation and Recovery Act, the Safe Drinking Water Act and other laws administered by EPA.

(c) These regulations provide for Phase 1 and 2 cooperative agreements. The purpose of a Phase 1 cooperative agreement is to allow a State to conduct a diagnostic-feasibility study to determine a lake's quality, evaluate possible solutions to existing pollution problems, and recommend a feasible program to restore or preserve the quality of the lake. A Phase 2 cooperative agreement is to be used for implementing recommended methods and procedures for controlling pollution entering the lake and restoring the lake. EPA award of Phase 1 assistance does not obligate EPA to award Phase 2 assistance for that project. Additionally, a Phase 1 award is not a prerequisite for receiving a Phase 2 award. However, a Phase 2 application for a proposed project that was not evaluated under a Phase 1 project shall contain the information required by Appendix A.

(d) EPA will evaluate all applications in accordance with the application review criteria of § 35.1640-1. The review criteria include technical feasibility, public benefit, reasonableness of proposed costs, environmental impact, and the State's priority ranking of the lake project.

(e) Before awarding funding assistance, the Regional Administrator shall determine that pollution control measures in the lake watershed authorized by section 201, included in an approved 208 plan, or required by section 402 of the Act are completed or are being implemented according to a schedule that is included in an approved plan or discharge permit. Clean lakes funds may not be used to control the discharge of pollutants from a point source where the cause of pollution can be alleviated through a municipal or industrial permit under section 402 of the Act or through the planning and construction of wastewater treatment facilities under section 201 of the Act.

§ 35.1605 Definitions.

The terms used in this subpart have the meanings defined in section 502 of the Act. In addition, the following terms shall have the meaning set forth below.

§ 35.1605-1 The Act.

The Clean Water Act, as amended (33 U.S.C. 1251 *et seq.*).

§ 35.1605-2 Freshwater lake.

Any inland pond, reservoir, impoundment, or other similar body of water that has recreational value, that exhibits no oceanic and tidal influences,

and that has a total dissolved solids concentration of less than 1 percent.

§ 35.1605-3 Publicly owned freshwater lake.

A freshwater lake that offers public access to the lake through publicly owned contiguous land so that any person has the same opportunity to enjoy non-consumptive privileges and benefits of the lake as any other person. If user fees are charged for public use and access through State or substate operated facilities, the fees must be used for maintaining the public access and recreational facilities of this lake or other publicly owned freshwater lakes in the State, or for improving the quality of these lakes.

§ 35.1605-4 Nonpoint source.

Pollution sources which generally are not controlled by establishing effluent limitations under sections 301, 302, and 402 of the Act. Nonpoint source pollutants are not traceable to a discrete identifiable origin, but generally result from land runoff, precipitation, drainage, or seepage.

§ 35.1605-5 Eutrophic lake.

A lake that exhibits any of the following characteristics: (a) Excessive biomass accumulations of primary producers; (b) rapid organic and/or inorganic sedimentation and shallowing; or (c) seasonal and/or diurnal dissolved oxygen deficiencies that may cause obnoxious odors, fish kills, or a shift in the composition of aquatic fauna to less desirable forms.

§ 35.1605-6 Trophic condition.

A relative description of a lake's biological productivity based on the availability of plant nutrients. The range of trophic conditions is characterized by the terms of oligotrophic for the least biologically productive, to eutrophic for the most biologically productive.

§ 35.1605-7 Desalinization.

Any mechanical procedure or process where some or all of the salt is removed from lake water and the freshwater portion is returned to the lake.

§ 35.1605-8 Diagnostic-feasibility study.

A two part study to determine a lake's current condition and to develop possible methods for lake restoration and protection.

(a) The diagnostic portion of the study includes gathering information and data to determine the limnological, morphological, demographic, socio-economic, and other pertinent characteristics of the lake and its watershed. This information will provide recipients an understanding of

the quality of the lake, specifying the location and loading characteristics of significant sources polluting the lake.

(b) The feasibility portion of the study includes: (1) Analyzing the diagnostic information to define methods and procedures for controlling the sources of pollution; (2) determining the most energy and cost efficient procedures to improve the quality of the lake for maximum public benefit; (3) developing a technical plan and milestone schedule for implementing pollution control measures and in-lake restoration procedures; and (4) if necessary, conducting pilot scale evaluations.

§ 35.1610 Eligibility.

EPA shall award cooperative agreements for restoring publicly owned freshwater lakes only to the State agency designated by the State's Chief Executive. The award will be for projects which meet the requirements of this subchapter.

§ 35.1613 Distribution of funds.

(a) For each fiscal year EPA will notify each Regional Administrator of the amount of funds targeted for each Region through annual clean lakes program guidance. To assure an equitable distribution of funds the targeted amounts will be based on the clean lakes program which States identify in their State WQM work programs.

(b) EPA may set aside up to twenty percent of the annual appropriations for Phase 1 projects.

§ 35.1615 Substate agreements.

States may make financial assistance available to substate agencies by means of a written interagency agreement transferring project funds from the State to those agencies. The agreement shall be developed, administered and approved in accordance with the provisions of 40 CFR 33.240 (Intergovernmental agreements). A State may enter into an agreement with a substate agency to perform all or a portion of the work under a clean lakes cooperative agreement. Recipients shall submit copies of all interagency agreements to the Regional Administrator. If the sum involved exceeds \$100,000, the agreement shall be approved by the Regional Administrator before funds are released by the State to the substate agency. The agreement shall incorporate by reference the provisions of this subchapter. The agreement shall specify outputs, milestone schedule, and the budget required to perform the associated work in the same manner as the cooperative agreement between the State and EPA.

§ 35.1620 Application requirements.

(a) EPA will process applications in accordance with Subpart B of Part 30 of this subchapter. Applicants for assistance under the clean lakes program shall submit EPA form 5700-33 (original with signature and two copies) to the appropriate EPA Regional Office (see 40 CFR 30.130).

(b) Before applying for assistance, applicants should contact the appropriate Regional Administrator to determine EPA's current funding capability.

§ 35.1620-1 Types of assistance.

EPA will provide assistance in two phases in the clean lakes program.

(a) *Phase 1—Diagnostic-feasibility studies.* Phase 1 awards of up to \$100,000 per award (requiring a 30 percent non-Federal share) are available to support diagnostic-feasibility studies (see Appendix A).

(b) *Phase 2—Implementation.* Phase 2 awards (requiring a 50 percent non-Federal share) are available to support the implementation of pollution control and/or in-lake restoration methods and procedures including final engineering design.

§ 35.1620-2 Contents of applications.

(a) All applications shall contain a written State certification that the project is consistent with State Water Quality Management work program (see § 35.1513 of this subchapter) and the State Comprehensive Outdoor Recreation Plan (if completed). Additionally, the State shall indicate the priority ranking for the particular project (see § 35.1620-5).

(b) Phase 1 applications shall contain: (1) A narrative statement describing the specific procedures that will be used by the recipient to conduct the diagnostic-feasibility study including a description of the public participation to be involved (see § 25.11 of this chapter);

(2) A milestone schedule;

(3) An itemized cost estimate

including a justification for these costs; (4) A written certification from the appropriate areawide or State 208 planning agency that the proposed work will not duplicate work completed under any 208 planning grant, and that the applicant is proposing to use any applicable approved 208 planning in the clean lakes project design; and

(5) For each lake being investigated, the information under subparagraph (5)(i) of this paragraph and, when available, the information under subparagraph (5)(ii) of this paragraph.

(i) Mandatory information.

(A) The legal name of the lake, reservoir, or pond.

(B) The location of the lake within the State, including the latitude and longitude, in degrees, minutes, and seconds of the approximate center of the lake.

(C) A description of the physical characteristics of the lake, including its maximum depth (in meters); its mean depth (in meters); its surface area (in hectares); its volume (in cubic meters); the presence or absence of stratified conditions; and major hydrologic inflows and outflows.

(D) A summary of available chemical and biological data demonstrating the past trends and current water quality of the lake.

(E) A description of the type and amount of public access to the lake, and the public benefits that would be derived by implementing pollution control and lake restoration procedures.

(F) A description of any recreational uses of the lake that are impaired due to degraded water quality. Indicate the cause of the impairment, such as algae, vascular aquatic plants, sediments, or other pollutants.

(G) A description of the local interests and fiscal resources committed to restoring the lake.

(H) A description of the proposed monitoring program to provide the information required in Appendix A paragraph (a)(10) of this section.

(ii) Discretionary information. States should submit this information when available to assist EPA in reviewing the application.

(A) A description of the lake watershed in terms of size, land use (list each major land use classification as a percentage of the whole), and the general topography, including major soil types.

(B) An identification of the major point source pollution discharges in the watershed. If the sources are currently controlled under the National Pollutant Discharge Elimination System (NPDES), include the permit numbers.

(C) An estimate of the percent contribution of total nutrient and sediment loading to the lake by the identified point sources.

(D) An indication of the major nonpoint sources in the watershed. If the sources are being controlled describe the control practice(s), including best land management practices.

(E) An indication of the lake restoration measures anticipated, including watershed management, and a projection of the net improvement in water quality.

(F) A statement of known or anticipated adverse environmental impacts resulting from lake restoration.

(c) Phase 2 applications shall include:

(1) The information specified in Appendix A in a diagnostic/feasibility study or its equivalent; (2) certification by the appropriate areawide or State 208 planning agencies that the proposed Phase 2 lake restoration proposal is consistent with any approved 208 planning; and (3) copies of all issued permits or permit applications (including a summary of the status of applications) that are required for the discharge of dredged or fill material under section 404 of the Act.

§ 35.1620-3 Environmental evaluation.

Phase 2 applicants shall submit an evaluation of the environmental impacts of the proposed project in accordance with the requirements in Appendix A of this regulation.

§ 35.1620-4 Public participation.

(a) *General.* (1) In accordance with this Part and Part 25 of this chapter, the applicant shall provide for, encourage, and assist public participation in developing a proposed lake restoration project.

(2) Public consultation may be coordinated with related activities to enhance the economy, the effectiveness, and the timeliness of the effort, or to enhance the clarity of the issue. This procedure shall not discourage the widest possible participation by the public.

(b) *Phase 1.* (1) Phase 1 recipients shall solicit public comment in developing, evaluating, and selecting alternatives; in assessing potential adverse environmental impacts; and in identifying measures to mitigate any adverse impacts that were identified. The recipient shall provide information relevant to these decisions, in fact sheet or summary form, and distribute them to the public at least 30 days before selecting a proposed method of lake restoration. Recipients shall hold a formal or informal meeting with the public after all pertinent information is distributed, but before a lake restoration method is selected. If there is significant public interest in the cooperative agreement activity, an advisory group to study the process shall be formed in accordance with the requirements of § 25.3(d)(4) of this chapter.

(2) A formal public hearing shall be held if the Phase 1 recipient selects a lake restoration method that involves major construction, dredging, or significant modifications to the environment, or if the recipient or the Regional Administrator determines that a hearing would be beneficial.

(c) *Phase 2.* (1) A summary of the recipient's response to all public

comments, along with copies of any written comments, shall be prepared and submitted to EPA with a Phase 2 application.

(2) Where a proposed project has not been studied under a Phase 1 cooperative agreement, the applicant for Phase 2 assistance shall provide an opportunity for public consultation with adequate and timely notices before submitting an application to EPA. The public shall be given the opportunity to discuss the proposed project, the alternatives, and any potentially adverse environmental impacts. A public hearing shall be held where the proposed project involves major construction, dredging or other significant modification of the environment. The applicant shall provide a summary of his responses to all public comments and submit the summary, along with copies of any written comments, with the application.

§ 35.1620-5 State work programs and lake priority lists.

(a)(1) A State shall submit to the Regional Administrator as part of its annual work program (§ 35.1513 of this subchapter) a description of the activities it will conduct during the Federal fiscal year to classify its lakes according to trophic condition (§ 35.1630) and to set priorities for implementing clean lakes projects within the State. The work plan must list in priority order the cooperative agreement applications that will be submitted by the State for Phase 1 and Phase 2 projects during the upcoming fiscal year, along with the rationale used to establish project priorities. Each State must also list the cooperative agreement applications, with necessary funding, which it expects to submit in the following fiscal year. This information will assist EPA in targeting resources under § 35.1613.

(2) A State may petition the Regional Administrator by letter to modify the EPA approved priority list established under paragraph (a)(1) of this section. This may be done at any time if the State believes there is sufficient justification to alter the priority list contained in its annual work program, e.g., if a community with a lower priority project has sufficient resources available to provide the required matching funding while a higher priority project does not, or if new data indicates that a lower priority lake will have greater public benefit than a higher priority lake.

(b) Clean lakes restoration priorities should be consistent with the Statewide water quality management strategy (see § 35.1511-2 of this subchapter). In

establishing priorities on particular lake restoration projects, States should use as criteria the application review criteria (§ 35.1640-1) that EPA will use in preparing funding recommendations for specific projects. If a State chooses to use different criteria, the State should indicate this to the Regional Administrator as part of the annual work program.

§ 35.1620-6 State and local clearinghouse procedures.

In accordance with § 30.305 of this subchapter, all requirements of OMB Circular A-95 must be met before States submit applications to EPA.

§ 35.1630 State lake classification surveys.

States that wish to participate in the clean lakes program shall establish and submit to EPA by January 1, 1982, a classification, according to trophic condition, of their publicly owned freshwater lakes that are in need of restoration or protection. After December 31, 1981, States that have not complied with this requirement will not be eligible for Federal financial assistance under this subpart until they complete their survey.

§ 35.1640 Application review and evaluation.

EPA will review applications as they are received. EPA may request outside review by appropriate experts to assist with technical evaluation. Funding decisions will be based on the merit of each application in accordance with the application review criteria under § 35.1640-1. EPA will consider Phase 1 applications separately from Phase 2 applications.

§ 35.1640-1 Application review criteria.

(a) When evaluating applications, EPA will consider information supplied by the applicant which address the following criteria:

(1) The technical feasibility of the project, and where appropriate, the estimated improvement in lake water quality.

(2) The anticipated positive changes that the project would produce in the overall lake ecosystem, including the watershed, such as the net reduction in sediment, nutrient, and other pollutant loadings.

(3) The estimated improvement in fish and wildlife habitat and associated beneficial effects on specific fish populations of sport and commercial species.

(4) The extent of anticipated benefits to the public. EPA will consider such factors as (i) the degree, nature and sufficiency of public access to the lake;

(ii) the size and economic structure of the population residing near the lake which would use the improved lake for recreational and other purposes; (iii) the amount and kind of public transportation available for transport of the public to and from the public access points; (iv) whether other relatively clean publicly owned freshwater lakes within 80 kilometer radius already adequately serve the population; and (v) whether the restoration would benefit primarily the owners of private land adjacent to the lake.

(5) The degree to which the project considers the "open space" policies contained in sections 201(f), 201(g), and 208(b)(2)(A) of the Act.

(6) The reasonableness of the proposed costs relative to the proposed work, the likelihood that the project will succeed, and the potential public benefits.

(7) The means for controlling adverse environmental impacts which would result from the proposed restoration of the lake. EPA will give specific attention to the environmental concerns listed in Section (c) of Appendix A.

(8) The State priority ranking for a particular project.

(9) The State's operation and maintenance program to ensure that the pollution control measures and/or in-lake restorative techniques supported under the project will be continued after the project is completed.

(b) For Phase 1 applications, the review criteria presented in paragraph (a) of this section will be modified in relation to the smaller amount of technical information and analysis that is available in the application. Specifically, under criterion (a)(1), EPA will consider a technical assessment of the proposed project approach to meet the requirements stated in Appendix A to this regulation. Under criterion (a)(4), EPA will consider the degree of public access to the lake and the public benefit. Under criterion (a)(7), EPA will consider known or anticipated adverse environmental impacts identified in the application or that EPA can presume will occur. Criterion (a)(9) will not be considered.

§ 35.1650 Award.

(a) Under 40 CFR 30.345, generally 90 days after EPA has received a complete application, the application will either be: (1) Approved for funding in an amount determined to be appropriate for the project; (2) returned to the applicant due to lack of funding; or (3) disapproved. The applicant shall be promptly notified in writing by the EPA Regional Administrator of any funding decisions.

(b) Applications that are disapproved can be submitted as new applications to EPA if the State resolves the issues identified during EPA review.

§ 35.1650-1 Project period.

(a) The project period for Phase 1 projects shall not exceed three years.

(b) The project period for Phase 2 projects shall not exceed four years. Implementation of complex projects and projects incorporating major construction may have longer project periods if approved by the Regional Administrator.

§ 35.1650-2 Limitations on awards.

(a) Before awarding assistance, the Regional Administrator shall determine that:

(1) The applicant has met all of the applicable requirements of § 35.1620 and § 35.1630; and

(2) State programs under section 314 of the Act are part of a State/EPA Agreement which shall be completed before the project is awarded.

(b) Before awarding Phase 2 projects, the Regional Administrator shall further determine that:

(1) When a Phase 1 project was awarded, the final report prepared under Phase 1 is used by the applicant to apply for Phase 2 assistance. The lake restoration plan selected under the Phase 1 project must be implemented under a Phase 2 cooperative agreement.

(2) Pollution control measures in the lake watershed authorized by section 201, included in an approved 208 plan, or required by section 402 of the Act have been completed or are being implemented according to a schedule that is included in an approved plan or discharge permit.

(3) The project does not include costs for controlling point source discharges of pollutants where those sources can be alleviated by permits issued under section 402 of the Act, or by the planning and construction of wastewater treatment facilities under section 201 of the Act.

(4) The State has appropriately considered the "open space" policy presented in sections 201(f), 201(g)(8), and 208(b)(2)(A) of the Act in any wastewater management activities being implemented by them in the lake watershed.

(5)(i) The project does not include costs for harvesting aquatic vegetation, or for chemical treatment to alleviate temporarily the symptoms of eutrophication, or for operating and maintaining lake aeration devices, or for providing similar palliative methods and procedures, unless these procedures are the most energy efficient or cost

effective lake restorative method. (ii) Palliative approaches can be supported only where pollution in the lake watershed has been controlled to the greatest practicable extent, and where such methods and procedures are a necessary part of a project during the project period. EPA will determine the eligibility of such a project, based on the applicant's justification for the proposed restoration, the estimated time period for improved lake water quality, and public benefits associated with the restoration.

(6) The project does not include costs for desalinization procedures for naturally saline lakes.

(7) The project does not include costs for purchasing or long term leasing of land used solely to provide public access to a lake.

(8) The project does not include costs resulting from litigation against the recipient by EPA.

(9) The project does not include costs for measures to mitigate adverse environmental impacts that are not identified in the approved project scope of work. (EPA may allow additional costs for mitigation after it has reevaluated the cost-effectiveness of the selected alternative and has approved a request for an increase from the recipient.)

§ 35.1650-3 Conditions on award.

(a) *All awards.* (1) All assistance awarded under the Clean Lakes program is subject to the EPA General Grant conditions (Subpart C and Appendix A of Part 30 of this chapter). (2) For each clean lakes project the State agrees to pay or arrange the payment of the non-Federal share of the project costs.

(b) *Phase 1.* Phase 1 projects are subject to the following conditions:

(1) The recipient must receive EPA project officer approval on any changes to satisfy the requirements of (a)(10) of Appendix A before undertaking any other work under the grant.

(2) (i) Before selecting the best alternative for controlling pollution and improving the lake, as required in paragraph (b)(1) of Appendix A of this regulation, and before undertaking any other work stated under paragraph (b) of Appendix A, the recipient shall submit an interim report to the project officer. The interim report must include a discussion of the various available alternatives and a technical justification for the alternative that the recipient will probably choose. The report must include a summary of the public involvement and the comments that occurred during the development of the alternatives. (ii) The recipient must obtain EPA project officer approval of

the selected alternative before conducting additional work under the project.

(c) *Phase 2.* Phase 2 projects are subject to the following conditions:

(1) (i) The State shall monitor the project to provide data necessary to evaluate the efficiency of the project as jointly agreed to and approved by the EPA project officer. The monitoring program described in paragraph (b)(3) of Appendix A of this regulation as well as any specific measurements that would be necessary to assess specific aspects of the project, must be considered during the development of a monitoring program and schedule. The project recipient shall receive the approval of the EPA project officer for a monitoring program and schedule to satisfy the requirements of Appendix A paragraph (b)(3) before undertaking any other work under the project. (ii) Phase 2 projects shall be monitored for at least one year after construction or pollution control practices are completed.

(2) The State shall manage and maintain the project so that all pollution control measures supported under the project will be continued during the project period at the same level of efficiency as when they were implemented. The State will provide reports regarding project maintenance as required in the cooperative agreement.

(3) The State shall upgrade its water quality standards to reflect a higher water quality use classification if the higher water quality use was achieved as a result of the project (see 40 CFR 35.1550(c)(2)).

(4) If an approved project allows purchases of equipment for lake maintenance, such as weed harvesters, aeration equipment, and laboratory equipment, the State shall maintain and operate the equipment according to an approved lake maintenance plan for a period specified in the cooperative agreement. In no case shall that period be for less than the time it takes to completely amortize the equipment.

(5) If primary adverse environmental impacts result from implementing approved lake restoration or protection procedures, the State shall include measures to mitigate these adverse impacts at part of the work under the project.

(6) If adverse impacts could result to unrecorded archeological sites, the State shall stop work or modify work plans to protect these sites in accordance with the National Historic Preservation Act. (EPA may allow additional costs for ensuring proper protection of unrecorded archeological sites in the project area after reevaluating the cost

effectiveness of the procedures and approving a request for a cost increase from the recipient.)

(7) If a project involves construction or dredging that requires a section 404 permit for the discharge of dredged or fill material, the recipient shall obtain the necessary section 404 permits before performing any dredge or fill work.

§ 35.1650-4 Payment.

(a) Under § 30.615 of this chapter, EPA generally will make payments through letter of credit. However, the Regional Administrator may place any recipient on advance payment or on cost reimbursement, as necessary.

(b) Phase 2 projects involving construction of facilities or dredging and filling activities shall be paid by reimbursement.

§ 35.1650-5 Allowable costs.

(a) The State will be paid under § 35.1650-4 for the Federal share of all necessary costs within the scope of the approved project and determined to be allowable under 40 CFR 30.705, the provisions of this subpart, and the cooperative agreement.

(b) Costs for restoring lakes used solely for drinking water supplies are not allowable under the Clean Lakes Program.

§ 35.1650-6 Reports.

(a) States with Phase 1 projects shall submit semi-annual progress reports (original and one copy) to the EPA project officer within 30 days after the end of every other standard quarter. Standard quarters end on March 31, June 30, September 30, and December 31. These reports shall include the following:

(1) Work progress relative to the milestone schedule, and difficulties encountered during the previous six months.

(2) A brief discussion of the project findings appropriate to the work conducted during the previous six months.

(3) A report of expenditures in the past six months and those anticipated in the next six months.

(b) *Phase 2.* States with Phase 2 projects shall submit progress reports (original and one copy) according to the schedule established in the cooperative agreement. The frequency of Phase 2 project progress reports shall be determined by the size and complexity of the project, and shall be required no more frequently than quarterly. The Phase 2 progress report shall contain all of the information required for Phase 1 progress reports indicated in paragraph (a) of this section. This report also must

include water quality monitoring data and a discussion of the changes in water quality which appear to have resulted from the lake restoration activities implemented during the reporting period.

(c) *Final Report.* States shall prepare a final report for all grants in accordance with § 30.635-2 of this subchapter. Phase 1 reports shall be organized according to the outline of information requirements stated in Appendix A. All water quality data obtained under the grant shall be submitted in the final report. Phase 2 reports shall conform to the format presented in the EPA manual on "Scientific and Technical Publications," May 14, 1974, as revised or updated. The States shall submit the report within 90 days after the project is completed.

(d) *Financial Status Report.* Within 90 days after the end of each budget period, the grantee shall submit to the Regional Administrator an annual report of all expenditures (Federal and non-Federal) which accrued during the budget period. Beginning in the second quarter of any succeeding budget period, payments may be withheld under § 30.615-3 of this chapter until this report is received.

Appendix A—Requirements for Diagnostic-Feasibility Studies and Environmental Evaluations

Phase 1 clean lakes projects shall include in their scope of work at least the following requirements, preferably in the order presented and under appropriate subheadings. The information required by paragraph (a)(1C) and the monitoring procedures stated in paragraph (b)(3) of this Appendix may be modified to conform to specific project requirements to reduce project costs without jeopardizing adequacy of technical information or the integrity of the project. All modifications must be approved by the EPA project officer as specified in §§ 35.1650-3(b)(1) and 35.1650-3(c)(1).

(a) A diagnostic study consisting of:

(1) An identification of the lake to be restored or studied, including the name, the State in which it is located, the location within the State, the general hydrologic relationship to associated upstream and downstream waters and the approved State water quality standards for the lake.

(2) A geological description of the drainage basin including soil types and soil loss to stream courses that are tributary to the lake.

(3) A description of the public access to the lake including the amount and type of public transportation to the access points.

(4) A description of the size and economic structure of the population residing near the lake which would use the improved lake for recreation and other purposes.

(5) A summary of historical lake uses, including recreational uses up to the present time, and how these uses may have changed because of water quality degradation.

(6) An explanation, if a particular segment of the lake user population is or will be more adversely impacted by lake degradation.

(7) A statement regarding the water use of the lake compared to other lakes within a 80 kilometer radius.

(8) An itemized inventory of known point source pollution discharges affecting or which have affected lake water quality over the past 5 years, and the abatement actions for these discharges that have been taken, or are in progress. If corrective action for the pollution sources is contemplated in the future, the time period should be specified.

(9) A description of the land uses in the lake watershed, listing each land use classification as a percentage of the whole and discussing the amount of nonpoint pollutant loading produced by each category.

(10) A discussion and analysis of historical baseline limnological data and one year of current limnological data. The monitoring schedule presented in paragraph (b)(3) of Appendix A must be followed in obtaining the one year of current limnological data. This presentation shall include the present trophic condition of the lake as well as its surface area (hectares), maximum depth (meters), average depth (meters), hydraulic residence time, the area of the watershed draining to the lake (hectares), and the physical, chemical, and biological quality of the lake and important lake tributary waters. Bathymetric maps should be provided. If dredging is expected to be included in the restoration activities, representative bottom sediment core samples shall be collected and analyzed using methods approved by the EPA project officer for phosphorus, nitrogen, heavy metals, other chemicals appropriate to State water quality standards, and persistent synthetic organic chemicals where appropriate. Further, the elutriate must be subjected to test procedures developed by the U.S. Army Corps of Engineers and analyzed for the same constituents. An assessment of the phosphorus (and nitrogen when it is the limiting lake nutrient) inflows and outflows associated with the lake and a hydraulic budget including ground water flow must be included. Vertical

temperature and dissolved oxygen data must be included for the lake to determine if the hypolimnion becomes anaerobic and, if so, for how long and over what extent of the bottom. Total and soluble reactive phosphorus (P); and nitrite, nitrate, ammonia and organic nitrogen (N) concentrations must be determined for the lake. Chlorophyll *a* values should be measured for the upper mixing zone. Representative alkalinities should be determined. Algal assay bottle test data or total N to total P ratios should be used to define the growth limiting nutrient. The extent of algal blooms, and the predominant algal genera must be discussed. Algal biomass should be determined through algal genera identification, cell density counts (numbers of cells per milliliter) and converted to cell volume based on factors derived from direct measurements; and reported in biomass of each major genus identified. Secchi disk depth and suspended solids should be measured and reported. The portion of the shoreline and bottom that is impacted by vascular plants (submersed, floating, or emergent higher aquatic vegetation) must be estimated, specifically the lake surface area between 0 and the 10 meter depth contour or twice the Secchi disk transparency depth, whichever is less, and that estimate should include an identification of the predominant species. Where a lake is subject to significant public contact use or is fished for consumptive purposes, monitoring for public health reasons should be part of the monitoring program. Standard bacteriological analyses and fish flesh analyses for organic and heavy metal contamination should be included.

(11) An identification and discussion of the biological resources in the lake, such as fish population, and a discussion of the major known ecological relationships.

(b) A feasibility study consisting of:

(1) An identification and discussion of the alternatives considered for pollution control or lake restoration and an identification and justification of the selected alternative. This should include a discussion of expected water quality improvement, technical feasibility, and estimated costs of each alternative. The discussion of each feasible alternative and the selected lake restoration procedure must include detailed descriptions specifying exactly what activities would be undertaken under each, showing how and where these procedures would be implemented, illustrating the engineering specifications that would be followed

including preliminary engineering drawings to show in detail the construction aspects of the project, and presenting a quantitative analysis of the pollution control effectiveness and the lake water quality improvement that is anticipated.

(2) A discussion of the particular benefits expected to result from implementing the project, including new public water uses that may result from the enhanced water quality.

(3) A Phase 2 monitoring program indicating the water quality sampling schedule. A limited monitoring program must be maintained during project implementation, particularly during construction phases or in-lake treatment, to provide sufficient data that will allow the State and the EPA project officer to redirect the project if necessary, to ensure desired objectives are achieved. During pre-project, implementation, and post-project monitoring activities, a single in-lake site should be sampled monthly during the months of September through April and biweekly during May through August. This site must be located in an area that best represents the limnological properties of the lake, preferably the deepest point in the lake. Additional sampling sites may be warranted in cases where lake basin morphometry creates distinctly different hydrologic and limnologic sub-basins; or where major lake tributaries adversely affect lake water quality. The sampling schedule may be shifted according to seasonal differences at various latitudes. The biweekly samples must be scheduled to coincide with the period of elevated biological activity. If possible, a set of samples should be collected immediately following spring turnover of the lake. Samples must be collected between 0800 and 1600 hours of each sampling day unless diel studies are part of the monitoring program. Samples must be collected between one-half meter below the surface and one-half meter off the bottom, and must be collected at intervals of every one and one-half meters, or at six equal depth intervals, whichever number of samples is less. Collection and analyses of all samples must be conducted according to EPA approved methods. All of the samples collected must be analyzed for total and soluble reactive phosphorus; nitrite, nitrate, ammonia, and organic nitrogen; pH; temperature; and dissolved oxygen. Representative alkalinities should be determined. Samples collected in the upper mixing zone must be analyzed for chlorophyll *a*. Algal biomass in the upper mixing zone should be determined through algal genera

identification, cell density counts (number of cells per milliliter) and converted to cell volume based on factors derived from direct measurements; and reported in terms of biomass of each major genera identified. Secchi disk depth and suspended solids must be measured at each sampling period. The surface area of the lake covered by macrophytes between 0 and the 10 meter depth contour or twice the Secchi disk transparency depth, whichever is less, must be reported. The monitoring program for each clean lakes project must include all the required information mentioned above, in addition to any specific measurements that are found to be necessary to assess certain aspects of the project. Based on the information supplied by the Phase 2 project applicant and the technical evaluation of the proposal, a detailed monitoring program for Phase 2 will be established for each approved project and will be a condition of the cooperative agreement. Phase 2 projects will be monitored for at least one year after construction or pollution control practices are completed to evaluate project effectiveness.

(4) A proposed milestone work schedule for completing the project with a proposed budget and a payment schedule that is related to the milestone.

(5) A detailed description of how non-Federal funds will be obtained for the proposed project.

(6) A description of the relationship of the proposed project to pollution control programs such as the section 201 construction grants program, the section 208 areawide wastewater management program, the Department of Agriculture Soil Conservation Service and Agriculture Stabilization and Conservation Service programs, the Department of Housing and Urban Development block grant program, the Department of Interior Heritage Conservation and Recreation Service programs and any other local, State, regional and Federal programs that may be related to the proposed project. Copies of any pertinent correspondence, contracts, grant applications and permits associated with these programs should be provided to the EPA project officer.

(7) A summary of public participation in developing and assessing the proposed project which is in compliance with Part 25 of this chapter. The summary shall describe the matters brought before the public, the measures taken by the reporting agency to meet its responsibilities under Part 25 and related provisions elsewhere in this chapter, the public response, and the agency's response to significant

comments. Part 25.8 responsiveness summaries may be used to meet appropriate portions of these requirements to avoid duplication.

(8) A description of the operation and maintenance plan that the State will follow, including the time frame over which this plan will be operated, to ensure that the pollution controls implemented during the project are continued after the project is completed.

(9) Copies of all permits or pending permit applications (including the status of such applications) necessary to satisfy the requirements of section 404 of the Act. If the approved project includes dredging activities or other activities requiring permits, the State must obtain from the U.S. Army Corps of Engineers or other agencies the permits required for the discharge of dredged or fill material under section 404 of the Act or other Federal, State or local requirements. Should additional information be required to obtain these permits, the State shall provide it. Copies of section 404 permit applications and any associated correspondence must be provided to the EPA project officer at the time they are submitted to the U.S. Army Corps of Engineers. After reviewing the 404 permit application, the project officer may provide recommendations for appropriate controls and treatment of supernatant derived from dredged material disposal sites to ensure the maximum effectiveness of lake restoration procedures.

(c) States shall complete and submit an environmental evaluation which considers the questions listed below. In many cases the questions cannot be satisfactorily answered with a mere "Yes" or "No". States are encouraged to address other considerations which they believe apply to their project.

(1) Will the proposed project displace any people?

(2) Will the proposed project deface existing residences or residential areas? What mitigative actions such as landscaping, screening, or buffer zones have been considered? Are they included?

(3) Will the proposed project be likely to lead to a change in established land use patterns, such as increased development pressure near the lake? To what extent and how will this change be controlled through land use planning, zoning, or through other methods?

(4) Will the proposed project adversely affect a significant amount of prime agricultural land or agricultural operations on such land?

(5) Will the proposed project result in a significant adverse effect on parkland,

other public land, or lands of recognized scenic value?

(6) Has the State Historical Society or State Historical Preservation Officer been contacted? Has he responded, and if so, what was the nature of that response? Will the proposed project result in a significant adverse effect on lands or structures of historic, architectural, archaeological or cultural value?

(7) Will the proposed project lead to a significant long-range increase in energy demands?

(8) Will the proposed project result in significant and long range adverse changes in ambient air quality or noise levels? Short term?

(9) If the proposed project involves the use of in-lake chemical treatment, what long and short term adverse effects can be expected from that treatment? How will the project recipient mitigate these effects?

(10) Does the proposal contain all the information that EPA requires in order to determine whether the project complies with Executive Order 11988 on floodplains? Is the proposed project located in a floodplain? If so, will the project involve construction of structures in the floodplain? What steps will be taken to reduce the possible effects of flood damage to the project?

(11) If the project involves physically modifying the lake shore or its bed or its watershed, by dredging, for example, what steps will be taken to minimize any immediate and long term adverse effects of such activities? When dredging is employed, where will the dredged material be deposited, what can be expected and what measures will the recipient employ to minimize any significant adverse impacts from its deposition?

(12) Does the project proposal contain all information that EPA requires in order to determine whether the project complies with Executive Order 11990 on wetlands? Will the proposed project have a significant adverse effect on fish and wildlife, or on wetlands or any other wildlife habitat, especially those of endangered species? How significant is this impact in relation to the local or regional critical habitat needs? Have actions to mitigate habitat destruction been incorporated into the project? Has the recipient properly consulted with appropriate State and Federal fish, game and wildlife agencies and with the U.S. Fish and Wildlife Service? What were their replies?

(13) Describe any feasible alternatives, to the proposed project in terms of environmental impacts, commitment of resources, public interest and costs and why they were not proposed.

(14) Describe other measures not discussed previously that are necessary to mitigate adverse environmental impacts resulting from the implementation of the proposed project.

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40 CFR Parts 51, 52

[FRL-1404-8]

Prevention of Significant Deterioration; Partial Stay of Regulations

AGENCY: Environmental Protection Agency (EPA).

ACTION: Partial stay of regulations.

SUMMARY: By the administrative order which appears below, EPA stays its existing regulations for the prevention of significant air quality deterioration, 40 CFR 51.24 and 52.21 (1978), as to any source or modification which either (1) would not be major under the amendments to those regulations proposed at 44 FR 51924 (September 5, 1979) or (2) would be located in an area designated under Section 107 of the Clean Air Act as nonattainment for each pollutant for which the source or modification would be major under the proposed amendments.

EFFECTIVE DATE: The effective date of the stay is the date of signature of this notice. (January 30, 1980)

FOR FURTHER INFORMATION CONTACT: James Weigold, Standards Implementation Branch (MD-15), Office of Air Quality Planning and Standards, Research Triangle Park, N.C. 27711, 919/541-5292.

SUPPLEMENTARY INFORMATION: In June 1979, the United States Court of Appeals for the District of Columbia Circuit in a preliminary opinion held invalid certain key provisions of the regulations for the prevention of significant air quality deterioration which EPA had promulgated approximately one year earlier ("the 1978 PSD regulations"). See *Alabama Power Company v. Costle*, 13 ERC 1225. Those regulations appear at 40 CFR 51.24 and 52.21 (1978).

In September 1979, EPA proposed comprehensive amendments to the 1978 PSD regulations in response to the preliminary opinion in *Alabama Power*. See 44 FR 51924. Among those amendments are rules that would replace the provisions the court held invalid. Also among them are important provisions that would complement the replacements, for example, certain *de minimis* exemptions (see *id.* at 51937-38).

On December 14, 1979, the Court of Appeals in a final opinion reaffirmed its earlier decisions on the validity of the provisions at issue in *Alabama Power*. See 13 ERC 1983. Hence, when the opinion comes into effect, it will render ineffective key elements of the 1978 PSD regulations.

EPA will be unable to complete the rulemaking it began in September until at least June 1980. The comments EPA has received so far are voluminous and raise important issues that deserve serious consideration. In addition, in response to numerous requests, EPA recently reopened the comment period for comment on the September proposals in light of the final opinion of the court. Furthermore, EPA is reanalyzing the proposed *de minimis* exemptions and completing an economic impact assessment of the proposals. Finally, internal review of drafts of the final amendments will require considerable time.

To avoid the uncertainty and confusion that would occur if the opinion came into effect before EPA completed the rulemaking it began in September, EPA and many of the petitioners in *Alabama Power* have asked the court to keep the opinion from coming into effect until June 2, 1980, on the condition that EPA issue the administrative stay which appears below.

The purpose of the administrative stay is to relieve from the permitting requirements of the 1978 PSD regulations roughly those sources and modifications that would not be subject to the permitting requirements of valid replacement regulations that would comport with the *Alabama Power* opinion. Obviously, it would be unfair and unnecessary to force such sources and modifications to get a PSD permit under the 1978 PSD regulations during this transition period.

EPA has decided to issue the administrative stay before the court acts on the request of the various parties in *Alabama Power*. Many persons are ready to begin construction of sources and modifications that would need a PSD permit under the 1978 PSD regulations, but not under valid replacement regulations. EPA has concluded that to allow the 1978 PSD regulations to interfere any longer with such construction would be both unfair and unnecessary. Hence, it is issuing the administrative stay which appears below.

EPA regards the issuance of the administrative stay as "nationally applicable" "final action" within the meaning of Section 307(b)(1) of the Clean Air Act (the "Act"), 42 U.S.C.

7607(b)(1). EPA does not, however, regard the stay as the "promulgation or revision of regulations" within the meaning of Section 307(d)(1)(I) of the Act, 42 U.S.C. 7607(d)(1)(I). The stay is merely an order providing equitable relief during the period before the completion of the rulemaking that EPA began in September. The procedural requirements of Section 307(d), therefore, do not apply to the issuance of the administrative stay.

In any event, those requirements, as well as the notice and comment requirements of Section 4 of the Administrative Procedure Act (the "APA"), 5 U.S.C. 553, do not apply for other reasons. First, meeting either set of requirements would be "contrary to the public interest" within the meaning of Section 4(b)(B) of the APA, 5 U.S.C. 553(b)(B), since it would unnecessarily delay the construction of those sources and modifications to which the stay applies. Meeting those requirements would also be "unnecessary" within the meaning of that section, since the stay provides relief which is generally consistent with the final opinion of the court in *Alabama Power*. Finally, meeting those requirements would be "impracticable" within the meaning of Section 4(b)(B), since it would defeat the very purpose of the stay: to provide relief as soon as possible and, together with a judicial stay of the effect of the final opinion, free the agency to concentrate on the rulemaking it began in September. See Clean Air Act § 307(d)(1)(N), 42 U.S.C. 7607(d)(1)(N). For the same reasons, EPA finds that it has good cause to make the administrative stay immediately effective. See APA § 4(d), 5 U.S.C. 553(d).

The administrative stay opens a gap in the coverage of the new source review requirements for nonattainment areas that EPA intends to close in the near future through the promulgation of final rules. In general, those nonattainment requirements currently do not apply to a source or modification that, although located in an area designated nonattainment for each pollutant for which it would be major, would not significantly impact those portions of the area where pollution actually exceeds the applicable national ambient air quality standard or standards (NAAQS). See, e.g., 40 CFR Part 51, Appendix S, § II(D), 44 FR 3283 (January 18, 1979). In establishing that "clean pocket" exemption, EPA assumed that PSD permitting requirements would apply to any such source or modification, thereby filling the coverage of the

C n Environmental Quality and
 f ncil of Economic Advisers; and
 ector of the Office of Manage-
 and Budget. The Committee will
 recommendations to the Presi-
 and the Congress later this year
 the desirability and possible design
 policy options including solid waste
 disposal charges, resource conserva-
 tion subsidies, direct product regula-
 tion, local solid waste user fees, and
 other policy proposals. They would
 like to include the public in the deci-
 sionmaking process and are soliciting
 views on these potential legislative ini-
 tiatives.

July 3, 1978.

BARBARA BLUM,
 Deputy Administrator,
 Environmental Protection Agency.
 (FPR Doc. 78-18816 Filed 7-7-78; 8:45 am)

[6560-01]

(FRL 923-5)

AVAILABILITY OF CLEAN LAKES GRANTS ASSISTANCE

AGENCY: U.S. Environmental Protec-
 tion Agency.

ACTION: Notice of Availability of
 Grants Assistance.

SUMMARY: The Environmental Pro-
 tection Agency (EPA) will provide fi-
 nancial assistance to States for the
 identification and classification of
 publicly owned freshwater lakes ac-
 cording to trophic condition and the
 establishment of a priority ranking for
 lakes determined in need of lake resto-
 ration, or the conduct of feasibility
 studies to determine methods and pro-
 cedures to protect or restore the qual-
 ity of such priority lakes. Matching
 grants (70-percent Federal/30-percent
 State) are available to States for this
 purpose.

EFFECTIVE DATE: July 10, 1978.

FOR FURTHER INFORMATION
 CONTACT:

Interested parties should contact the
 appropriate EPA regional office (see
 app. C) or Mr. Kenneth M. Mack-
 enthun, Director, Criteria and
 Standards Division (WH-585), U.S.
 Environmental Protection Agency,
 Washington, D.C. 20460; 202-755-
 0100, to obtain additional guidance
 for the development of acceptable
 proposals.

SUPPLEMENTARY INFORMATION:

Section 314(a) of the Clean Water Act,
 as amended (33 U.S.C. 466, et seq.)
 states that—

Each State shall prepare or establish, and
 submit to the Administrator for his approval—
 (1) an identification and classification
 according to eutrophic condition of all pub-
 licly owned freshwater lakes in such State;

(2) procedures, processes, and methods (in-
 cluding land use requirements), to control
 sources of pollution of such lakes; and (3)
 methods and procedures, in conjunction
 with appropriate Federal agencies, to re-
 store the quality of such lakes.

Section 314(b) states that the Ad-
 ministrator shall provide financial as-
 sistance to States for carrying out ap-
 proved methods and procedures in-
 cluding lake identification and classifi-
 cation surveys.

EPA currently is developing regula-
 tions to administer EPA grant assist-
 ance under section 314. The public
 notice of this intent was published in
 the FEDERAL REGISTER (43 FR 20821,
 May 15, 1978). The regulations will re-
 quire the States to establish and
 submit to the Agency a classification
 and priority listing of publicly owned
 freshwater lakes in need of restorative
 action. This lake classification and pri-
 ority listing would be used by the
 States to implement technically feasi-
 ble lake restorative methods and pro-
 cedures.

Matching grants to States of up to
 \$100,000 Federal funds per State (70-
 percent Federal/30-percent State) are
 available to assist with the establish-
 ment of a State's lake classification
 survey and a lake restoration priority
 ranking, or feasibility studies to estab-
 lish methods and procedures to restore
 particular lakes. The minimum
 amount of work required under the
 grant will consist of the survey, classi-
 fication, and restoration priority rank-
 ing of significant publicly owned
 freshwater lakes. A significant lake is
 any lake determined by the State to
 have substantial public interest and
 use, and restoration of the lake would
 provide a cost-effective increase in
 public benefit. It is expected that a
 State will classify and prioritize within
 2 years from the date of this notice all
 publicly owned freshwater lakes
 within the State for which restorative
 assistance under the EPA clean lakes
 program may be requested. A final
 report and two copies presenting the
 classification and priority ranking is
 due within 18 months from the grant
 award date. Funds may be used by the
 grantee to conduct diagnostic or feasi-
 bility studies to determine appropriate
 restorative methods and procedures on
 those lakes designated with the high-
 est State priorities. Fiscal year 1978 re-
 sources to support this grant activity
 are limited, but resources are expected
 in fiscal year 1979 to continue this
 effort.

Grant requests will be evaluated and
 awarded on the basis of merit in com-
 parison with other grant applications.
 Any grants awarded must comply with
 the general grant regulations in 40
 CFR Part 30 and any additional grant
 requirements incorporated in the
 grant agreement. Semiannual progress
 reports must be submitted to the
 Agency project officer.

Guidance for the development of
 lake classification information is pre-
 sented in appendix A; guidance for the
 conduct of diagnostic or feasibility
 studies is presented in appendix B.
 Grant requests should be submitted
 on EPA form 5700-33 in an original
 with signature to the appropriate EPA
 regional office within 30 days from the
 date of this notice for consideration
 for fiscal year 1978 funding. The grant
 request narrative should contain the
 plan of action proposed to be used by
 the State to survey their lakes, the
 method to be used in establishing the
 State restoration priority ranking for
 the surveyed lakes, and the expected
 number of lakes to be surveyed and di-
 agnostic studies to be conducted. A
 cost estimate and budget rationale for
 conducting the lake classification
 survey, establishing a priority ranking
 of the surveyed lakes, and performing
 specific diagnostic and feasibility stud-
 ies must be included.

Interested State representatives
 should contact the appropriate EPA
 regional office (see app. C) or Mr.
 Kenneth M. Mackenthun, Director,
 Criteria and Standards Division (WH-
 585), U.S. Environmental Protection
 Agency, Washington, D.C. 20460, 202-
 755-0100, to obtain additional guid-
 ance for the development of accept-
 able lake classification surveys and
 grant applications.

Dated: June 30, 1978.

SWEP T. DAVIS,
 Acting Assistant Administrator
 for Water and Hazardous Ma-
 terials (WH-556.)

APPENDIX A

GUIDANCE FOR DEVELOPMENT OF LAKE CLASSIFICATION INFORMATION

Classifications or inventories of eutrophic
 lakes should include necessary physical,
 chemical, and biological lake characteristics
 to afford a description of lake water quality
 to a degree that it can be effectively utilized
 by the State agency and EPA in setting pri-
 orities on lake restoration activities and in
 determining the nature and extent of a
 State's lake eutrophication problem. A sug-
 gested information reporting format is
 listed below. This format should not be con-
 sidered exclusive and each State is encour-
 aged to develop a precise classification
 system to meet the individual State's needs.
 For each lake surveyed the report must in-
 clude:

The official name of the lake, reservoir, or
 pond that is legally used to identify it.

The location of the lake within the State,
 including the latitude and longitude in de-
 grees and minutes, of the approximate
 center of the lake.

A summary of available chemical and bi-
 ological data demonstrating the current
 water quality of the lake.

An indication if the lake was surveyed in
 the National Eutrophication Survey con-
 ducted by EPA.

An indication that the lake is publicly
 owned and affords the same opportunity for
 recreational usage to any citizen of the

Council on Environmental Quality and the Council of Economic Advisers; and the Director of the Office of Management and Budget. The Committee will make recommendations to the President and the Congress later this year on the desirability and possible design of policy options including solid waste disposal charges, resource conservation subsidies, direct product regulation, local solid waste user fees, and other policy proposals. They would like to include the public in the decisionmaking process and are soliciting views on these potential legislative initiatives.

July 3, 1978.

BARBARA BLUM,
Deputy Administrator,
Environmental Protection Agency.
(FR Doc. 78-18816 Filed 7-7-78; 8:45 am)

[6560-01]

[FRL 923-5]

AVAILABILITY OF CLEAN LAKES GRANTS ASSISTANCE

AGENCY: U.S. Environmental Protection Agency.

ACTION: Notice of Availability of Grants Assistance.

SUMMARY: The Environmental Protection Agency (EPA) will provide financial assistance to States for the identification and classification of publicly owned freshwater lakes according to trophic condition and the establishment of a priority ranking for lakes determined in need of lake restoration, or the conduct of feasibility studies to determine methods and procedures to protect or restore the quality of such priority lakes. Matching grants (70-percent Federal/30-percent State) are available to States for this purpose.

EFFECTIVE DATE: July 10, 1978.

FOR FURTHER INFORMATION CONTACT:

Interested parties should contact the appropriate EPA regional office (see app. C) or Mr. Kenneth M. Mackenthun, Director, Criteria and Standards Division (WH-585), U.S. Environmental Protection Agency, Washington, D.C. 20460; 202-755-0100, to obtain additional guidance for the development of acceptable proposals.

SUPPLEMENTARY INFORMATION:

Section 314(a) of the Clean Water Act, as amended (33 U.S.C. 466, et seq.) states that—

Each State shall prepare or establish, and submit to the Administrator for his approval—(1) an identification and classification according to eutrophic condition of all publicly owned freshwater lakes in such State;

(2) procedures, processes, and methods (including land use requirements), to control sources of pollution of such lakes; and (3) methods and procedures, in conjunction with appropriate Federal agencies, to restore the quality of such lakes.

Section 314(b) states that the Administrator shall provide financial assistance to States for carrying out approved methods and procedures including lake identification and classification surveys.

EPA currently is developing regulations to administer EPA grant assistance under section 314. The public notice of this intent was published in the FEDERAL REGISTER (43 FR 20821, May 15, 1978). The regulations will require the States to establish and submit to the Agency a classification and priority listing of publicly owned freshwater lakes in need of restorative action. This lake classification and priority listing would be used by the States to implement technically feasible lake restorative methods and procedures.

Matching grants to States of up to \$100,000 Federal funds per State (70-percent Federal/30-percent State) are available to assist with the establishment of a State's lake classification survey and a lake restoration priority ranking, or feasibility studies to establish methods and procedures to restore particular lakes. The minimum amount of work required under the grant will consist of the survey, classification, and restoration priority ranking of significant publicly owned freshwater lakes. A significant lake is any lake determined by the State to have substantial public interest and use, and restoration of the lake would provide a cost-effective increase in public benefit. It is expected that a State will classify and prioritize within 2 years from the date of this notice all publicly owned freshwater lakes within the State for which restorative assistance under the EPA clean lakes program may be requested. A final report and two copies presenting the classification and priority ranking is due within 18 months from the grant award date. Funds may be used by the grantee to conduct diagnostic or feasibility studies to determine appropriate restorative methods and procedures on those lakes designated with the highest State priorities. Fiscal year 1978 resources to support this grant activity are limited, but resources are expected in fiscal year 1979 to continue this effort.

Grant requests will be evaluated and awarded on the basis of merit in comparison with other grant applications. Any grants awarded must comply with the general grant regulations in 40 CFR Part 30 and any additional grant requirements incorporated in the grant agreement. Semiannual progress reports must be submitted to the Agency project officer.

Guidance for the development of lake classification information is presented in appendix A; guidance for the conduct of diagnostic or feasibility studies is presented in appendix B. Grant requests should be submitted on EPA form 5700-33 in an original with signature to the appropriate EPA regional office within 30 days from the date of this notice for consideration for fiscal year 1978 funding. The grant request narrative should contain the plan of action proposed to be used by the State to survey their lakes, the method to be used in establishing the State restoration priority ranking for the surveyed lakes, and the expected number of lakes to be surveyed and diagnostic studies to be conducted. A cost estimate and budget rationale for conducting the lake classification survey, establishing a priority ranking of the surveyed lakes, and performing specific diagnostic and feasibility studies must be included.

Interested State representatives should contact the appropriate EPA regional office (see app. C) or Mr. Kenneth M. Mackenthun, Director, Criteria and Standards Division (WH-585), U.S. Environmental Protection Agency, Washington, D.C. 20460; 202-755-0100, to obtain additional guidance for the development of acceptable lake classification surveys and grant applications.

Dated: June 30, 1978.

SWEEP T. DAVIS,
Acting Assistant Administrator
for Water and Hazardous Materials (WH-556.)

APPENDIX A

GUIDANCE FOR DEVELOPMENT OF LAKE CLASSIFICATION INFORMATION

Classifications or inventories of eutrophic lakes should include necessary physical, chemical, and biological lake characteristics to afford a description of lake water quality to a degree that it can be effectively utilized by the State agency and EPA in setting priorities on lake restoration activities and in determining the nature and extent of a State's lake eutrophication problem. A suggested information reporting format is listed below. This format should not be considered exclusive and each State is encouraged to develop a precise classification system to meet the individual State's needs. For each lake surveyed the report must include:

The official name of the lake, reservoir, or pond that is legally used to identify it.

The location of the lake within the State, including the latitude and longitude in degrees and minutes, of the approximate center of the lake.

A summary of available chemical and biological data demonstrating the current water quality of the lake.

An indication if the lake was surveyed in the National Eutrophication Survey conducted by EPA.

An indication that the lake is publicly owned and affords the same opportunity for recreational usage to any citizen of the

United States as to the property owners surrounding the lake.

A description of any inherent recreational values of the lake that are currently impaired due to degraded water quality; indicate the cause of such impairment such as algae, vascular aquatic plants, or sediments.

A description of the general physical characteristics of the lake including maximum depth (in meters); mean depth (in meters); surface area (in hectares); volume (in cubic meters); presence or absence of stratified conditions; and major inflows and outflows.

A description of the lake watershed in terms of area, land use (list each major land-use classification as a percentage of the whole), and the general topography including major soil types.

An identification of the major point source pollution discharges in the watershed; indicate if the source is currently controlled under the National Pollution Discharge Elimination System (NPDES), and if so, include the permit number.

An identification of the major nonpoint pollution sources in the watershed. Indicate if the source is being controlled and include a description of the control practice(s) including best land management practices.

A list of the name and address of any designated local or State 208 planning or management agencies with authority in the lake's drainage basin.

A description of the local interests and resource commitment in restoring the lake.

An indication of the probable lake restoration measures required, when applicable including land treatment required.

APPENDIX B

GUIDANCE FOR FEASIBILITY STUDIES

Clean Lakes proposals to implement lake restoration methods and procedures or to conduct diagnostic or feasibility studies leading to such implementation should include at least the following information preferably in the order presented and under appropriate subheadings:

An identification of the waters to be restored or studied, including their name, State in which located, location within the State, area, maximum depth, average depth, detention time, and general relationship with associated upstream and downstream waters.

A geological description of the drainage basin including soil types and soil loss to stream courses that are tributary to the lake.

A summary of historical lake uses including recreational lake uses through the present time and how these may have changed through the years because of water quality degradation. A statement must be made regarding the water use of this lake compared to other lakes within a 50-mile radius.

An itemized inventory of known point source domestic or industrial pollutional discharges affecting or which have affected lake water quality over the past 5 years and the abatement actions that have been taken, are in progress, or are contemplated within a specified time period.

An identification and discussion of the particular water quality problems involved, including historical (if available) and current test data and limnological data to support the water quality statement. One year of current baseline data should be included.

For lake restoration project implementation, a discussion and analysis of current baseline data and a proposed monitoring or in-

vestigative program with schedule for evaluation of the lake restoration project during the period of its implementation and at least one year after completion. Such data must include the present trophic condition of the water body as well as its surface area, maximum depth, average depth, hydraulic residence time, area of the watershed draining to the lake, and the physical, chemical, and biological impact of important tributaries. Bathymetric maps should be provided and, where dredging is part of the restoration plan, representative bottom sediment core samples and analyses for nutrient content, heavy metals, and persistent organic chemicals must be provided. An assessment of nitrogen and phosphorus inflows and outflows associated with the lake and a hydraulic budget including ground water flow must be included. Vertical temperature and dissolved oxygen data are essential and it must be determined if the hypolimnion becomes anaerobic and, if so, for how long and over what extent of the bottom. The extent of algal blooms, and the predominant algal species must be discussed. The portion of the shoreline and bottom that is impacted by vascular plants (submersed, floating, or emerged higher aquatic vegetation) must be estimated and that estimate must include an identification of the predominant species. A detailed monitoring program will be established for each approved project and will be specified in any grant agreement supporting implementation of restorative procedures. Periodic guidance for monitoring methods and procedures will be provided.

An identification and discussion of the biological resources in the lake, such as fish populations, and the major known ecological relationships.

An identification and discussion of the alternatives for pollution control or restorative action considered; and identification and justification of the selected alternative including a discussion of expected water quality improvement, technical feasibility, and estimated costs.

A discussion of the particular public benefits expected to result from implementation of the project, including new public water uses that may be associated with the enhanced water quality.

A proposed milestone work schedule for project completion with a proposed budget and payment schedule relating to progress milestones.

Evidence that all requirements of OMB Circular A-95 have been met.

A description of pertinent relationships of the proposed project to local, State and Federal pollution control programs, section 208 areawide wastewater management agencies, Soil Conservation Service programs as described by Pub. L. 83-566, Department of Housing and Urban Development programs, and any other local, State and Federal programs which may bear a relationship to the proposed project.

In order to minimize the programmatic impacts of a project in the event that significant adverse impacts are expected, applicants are required to submit an environmental assessment taking into consideration the questions listed below. In many cases the questions cannot be satisfactorily answered with a mere "Yes" or a "No" and may require a quantitative answer. This list is not exclusive and applicants are encouraged to address other considerations which they believe apply to their project.

1. Will the proposed project result in the displacement of any human population?

2. Will the proposed project result in the defacement of existing residences or residential areas? What mitigative actions such as landscaping, screening, or buffer zones have been considered? Are they included?

3. Will the proposed project be likely to lead to a change in established land use patterns, such as increased development pressure near the lake? To what extent will this change be controlled through land use planning, zoning, or through other methods?

4. How does this project conform to areawide waste treatment management plans, if any, in accordance with section 208 of the act?

5. Will the proposed project adversely affect a significant amount of agricultural land or agricultural operations on this land?

6. Will the proposed project result in a significant adverse effect on parkland, other public land, or lands of recognized scenic value?

7. Will the proposed project result in a significant adverse effect on lands or structures of historic, architectural, archaeological or cultural value? If so has the State Historical Society or State Historical Preservation Officer been contacted? What reply?

8. Will the proposed project lead to a significant long-range increase in energy demands?

9. Will the proposed project result in significant and long range adverse changes to ambient air quality or noise levels? Short term?

10. If the proposed project involves the use of in-lake chemical treatment, what long and short term adverse effects are to be expected from such treatment? How will such effects be mitigated?

11. Is the proposed project located in a floodplain? If so, will the project involve the construction of structures in the floodplain? What steps will be taken to reduce the possible effects of flood damage to the project?

12. If the project involves the physical modification of the lake shore or its bed, through dredging for example, what steps will be taken to minimize any immediate adverse effects of such activities? Have the appropriate State and Federal agencies (e.g., U.S. Army Corps of Engineers) been consulted to obtain permits or approvals for such activities where necessary? When dredging is employed, where will the dredge spoil be deposited, what will the expected impacts be, and what measures will be employed to minimize any significant adverse impacts from its deposition?

13. Will the proposed project have a significant adverse effect on fish and wildlife and wetlands or any other wildlife habitat, especially those of endangered species? What is the significance of this impact in relation to the local or regional critical habitat needs? Have mitigative actions for habitat destruction been considered? Has proper consultation been made with appropriate State and Federal fish, game and wildlife agencies? What reply?

14. Describe any feasible alternatives to the proposed project in terms of environmental impacts, commitments of resources and costs and why, in balance, they were not proposed.

15. Summarize any additional objections and comments (including favorable) which have been made on this project by Federal, State, or local agencies and interested persons.

16. Has public comment on this proposed project been solicited through hearings and what were the results?

Appendix C

C1 NONPOINT SOURCE LOADINGS

C2 BEST MANAGEMENT PRACTICES

C3 INSTITUTIONAL

- Evaluation Methodology
- Examples of Management Institutions

C1 NONPOINT SOURCE LOADINGS

Introduction

This appendix presents estimates of pollutant loads and discusses control techniques associated with lake eutrophication problems. The problems are assumed to be caused by excessive biostimulation of plankton and rooted aquatic plants. The contaminants of primary concern are nitrogen and phosphorus. Information on other contaminants will be presented if included in the original citation.

Nutrient Input Levels

The level of nutrient input is expressed either as a mass loading per unit of land area per unit time or as a concentration of pollutant. Reckhow, et al. (1980) present the most comprehensive summary to date of nitrogen and phosphorus loads expressed in units of kg/ha-yr. Omernik (1977) presents the most comprehensive summary of information on nutrient concentrations. An indirect way to estimate nutrient loads is to use the Universal Soil Loss Equation to predict annual soil loss (McElroy, et al. 1976; Wischmeier and Smith, 1965; Davis and Nebgen, 1979). This estimate is multiplied by an enrichment coefficient to determine the corresponding

nutrient load (Zison, 1980). There is no single correct way to express the quantity of nutrient input to a lake. Loads or concentrations may be used given that they result from a properly performed integration of the short-term fluxes into a total annual input.

Selection of an Averaging Time

Reported literature values of nutrient fluxes may represent short term (minutes or hours), intermediate (storm event, weekly, or monthly) or longer term (seasonal or annual) averages. The appropriate averaging time depends on the purpose of the study. For analyzing nutrient inputs to lakes, the appropriate averaging time is usually 1 year since the approximate hydraulic residence time in lakes is of this order of magnitude and the concentration value is a long-term average. Short-term, high concentration transients are not of primary concern.

As a general rule, the study period should be keyed to the average time it takes a parcel of water to travel through the lake. Reckhow (1979) reports hydraulic detention times from 82 lakes ranging from 1 day to 57.6 years.

The sampling interval and duration selected should be determined by the averaging period which will be used to characterize input loads. For lakes with hydraulic detention of almost a year or more than a year, average annual inputs are of primary concern. In this case, monitoring efforts should cover at least 1 year, and the frequency at which samples are taken should be such that seasonal and other important variations can be adequately characterized in order to permit a reliable estimate of annual loads. For lakes with very short hydraulic detentions (days or weeks), the annual average load may be less pertinent than a monthly or seasonal average. In such cases, a monitoring program of several months may suffice, though this will often call for a shorter sampling interval than would suffice for annual load estimates.

Care must be taken that data from such monitoring efforts is evaluated properly in developing estimates of average loadings. One common error is introduced by not properly "flow-weighting" observed concentrations. As an example, the lower portion of Figure C1-1 shows a typical hydrograph for a hypothetical river dis-

charging into a lake, based on daily streamflow measurements that are typically available from U.S. Geological Survey records. The upper portion shows 12 measurements of nutrient concentrations taken every 30 days over the year. Quality data of this type may be available from EPA's STORET data base.

A too-frequently used approach calculates the annual flux as the product of the arithmetic average nutrient concentration measurements and the average daily flow. This method may give very misleading results. For example, Smith (1976), in a study of phosphorus transport from two New Jersey watersheds, found that a disproportionate share of the total phosphorus load was contributed by the more intense storms.

Various techniques are available for "flow-weighting" observed concentrations, to improve estimates of average loads. In the situation illustrated by Figure C1-1, the simplest method would be to divide the year into 12 periods, each assumed to be characterized by one of the concentrations plotted. The average flow for that period is estimated and used to calculate 1/12 of the annual load. The sum of all 12 ele-

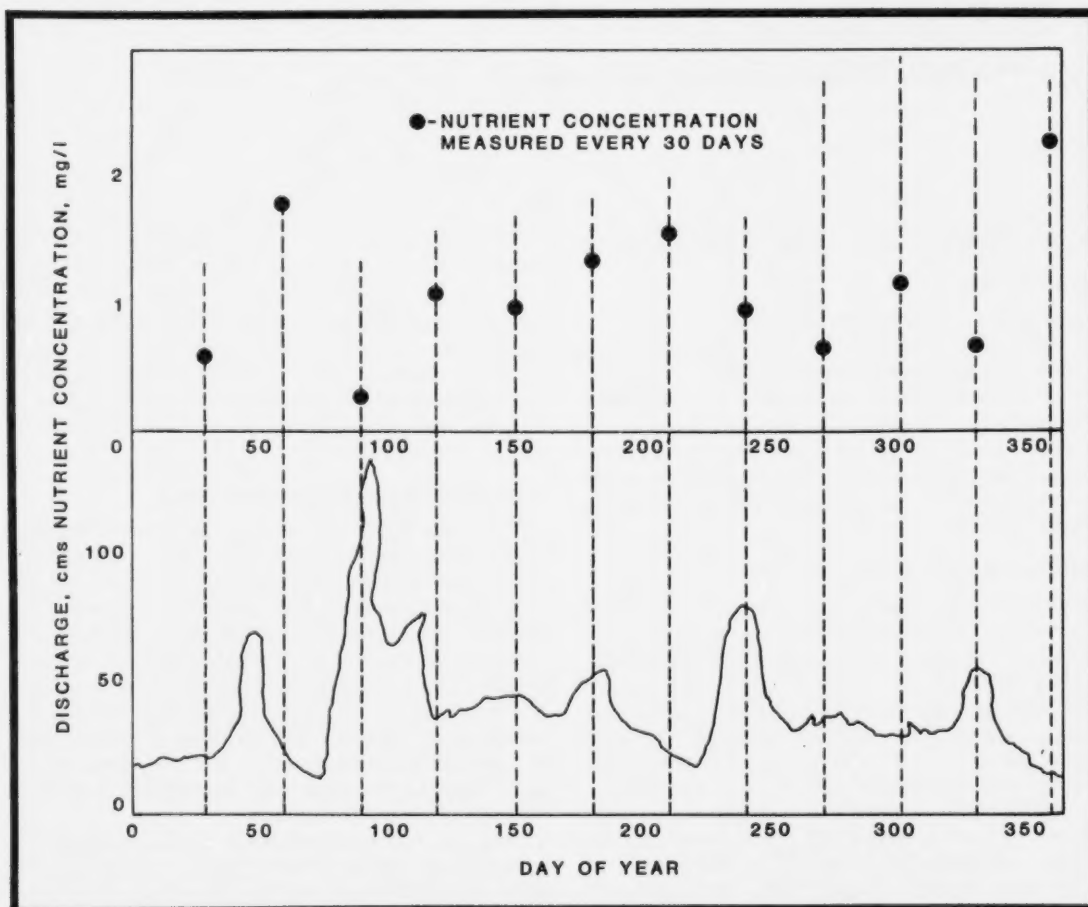


Figure C1-1. Discharge and Nutrient Concentration Versus Time for a Hypothetical River.

ments provides one estimate of the annual load. An alternative approach would be to analyze this data to define a correlation between flow and concentration. If the data should show an acceptable correlation (limited data may result in too much scatter to define such a relationship with any confidence), then the annual load would be calculated from the product of the average annual flow and the concentration corresponding to that flow.

Procedures for estimating annual input levels have been developed for suspended solids based on many years of experience (Guy, 1964). This data base is far better than for nutrients. Twenty years of daily sediment measurements are available for several streams. The component of suspended solids which is of prime importance for nutrient transport is the wash-load of finer solids transported from the land during runoff periods. Careful analysis by Rendon-Herrero (1974) indicated that relatively good relationships can be found between suspended solids load (SS) and the storm event surface runoff component of the hydrograph. The resulting rating curve is of the form:

$$SS = aQ^b \quad (C1-1)$$

where SS = suspended solids load (mass units per event)
 Q = storm runoff (volume per event)
 a, b = coefficient

The value of b is important. If (from evaluation of site data):

- b > 1, then SS concentration increases as flow increases,
- b = 1, then SS concentration is constant, or
- b < 1, then SS concentration decreases as flow increases.

Assuming nutrient loads are a linear function of suspended solids, these nutrients will be transported in the same manner. Note that if b is greater than 1, then the larger storms are of prime importance whereas if b is less than 1 the smaller storms take on greater relative importance. This information is vital to establishing a proper control program.

Lacking such a refined data base, local data need to be gathered and compared to existing numbers to derive better estimates of nutrient loads. Prior knowledge of the area should provide good clues as to when the most significant nutrient transfers occur, e.g., immediately after fertilization when agricultural land is still fallow. If the primary cause of the problem appears to be related to soil erosion then the Universal Soil Loss Equation should be used because it can approximate seasonal changes and the impact of erosion control best management practices

(BMP). If septic tank seepage and/or sewage effluent appear to be of prime importance, then unit area loading factors are appropriate.

The next subsections summarize the available literature values. While they provide some general information regarding nutrient levels in similar situations, local information is essential to a meaningful analysis.

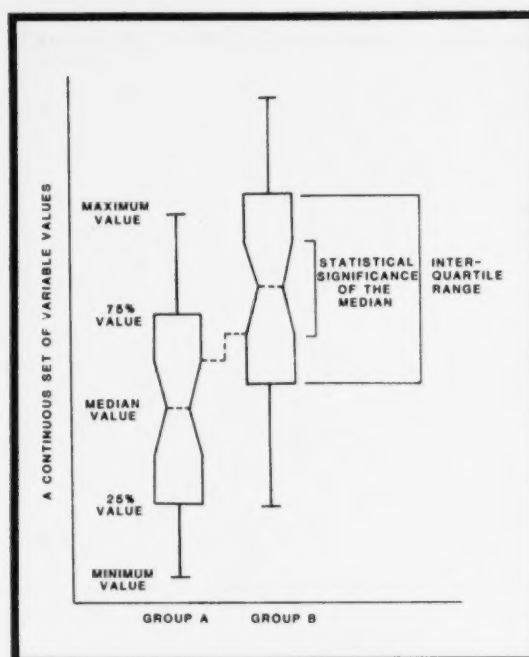


Figure C1-2. The Basic Configuration of a Box Plot and Comparison of the Plots Processing Significantly Different Medians (Reckhow, et al. 1980).

Annual Unit Area Loads (Export Coefficients)

The recently completed report by Reckhow, et al. (1980), provides the most complete summary of available export coefficients. Only catchments with at least 1 year of data were included. However, the report does not indicate how the loads were calculated. Also, the unit loads are assumed to be independent of runoff. No general procedures for accounting for catchment size are provided. Nevertheless, a large number of catchments are included. Thus, a good possibility exists that local study areas may be matched with one in the Reckhow report which has similar characteristics (land use, precipitation pattern, size).

General results from this study are presented in Figures C1-3 and C1-4, following Figure C1-2, which explains the measures of central tendency and variability. The median load is used because of the large amount of variability in the data. Use

of the median is preferable if the coefficient of variation (standard deviation divided by the mean) is greater than 1.

Annual Unit Area Concentration

Omernik (1977) summarizes mean (not median) phosphorus and nitrogen concentrations based on analysis of 730 watersheds throughout the United States. These watersheds were sampled as part of the National Eut-

rophication Survey. The results for nitrogen and phosphorus are shown in Figures C1-5 and C1-6, respectively.

Using *mean* concentration probably leads to higher estimates than Reckhow, et al. (1980) found because of the disproportionate influence of a few high values of concentrations.

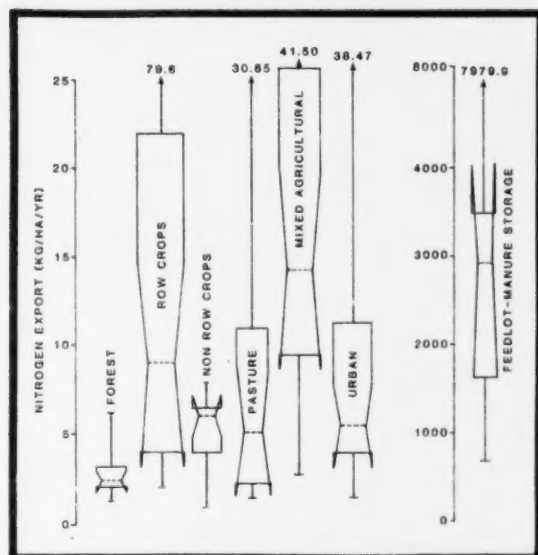


Figure C1-3. Box Plots of Nitrogen Export Coefficients from Various Land Uses (Reckhow, et al. 1980).

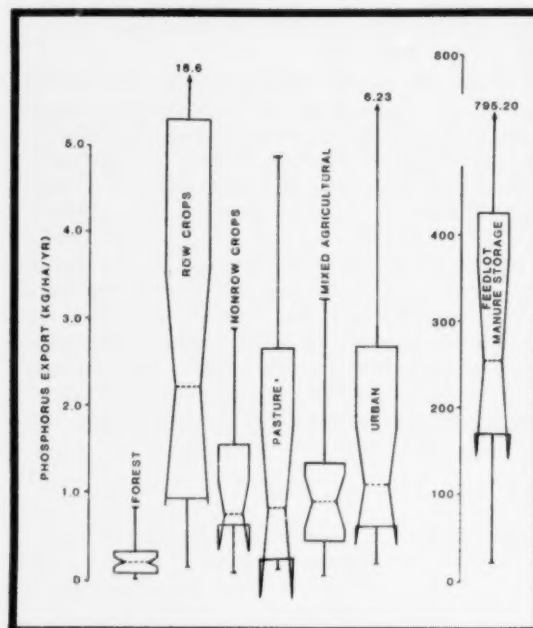


Figure C1-4. Box Plots of Phosphorus Export Coefficients from Various Land Uses (Reckhow, et al. 1980).

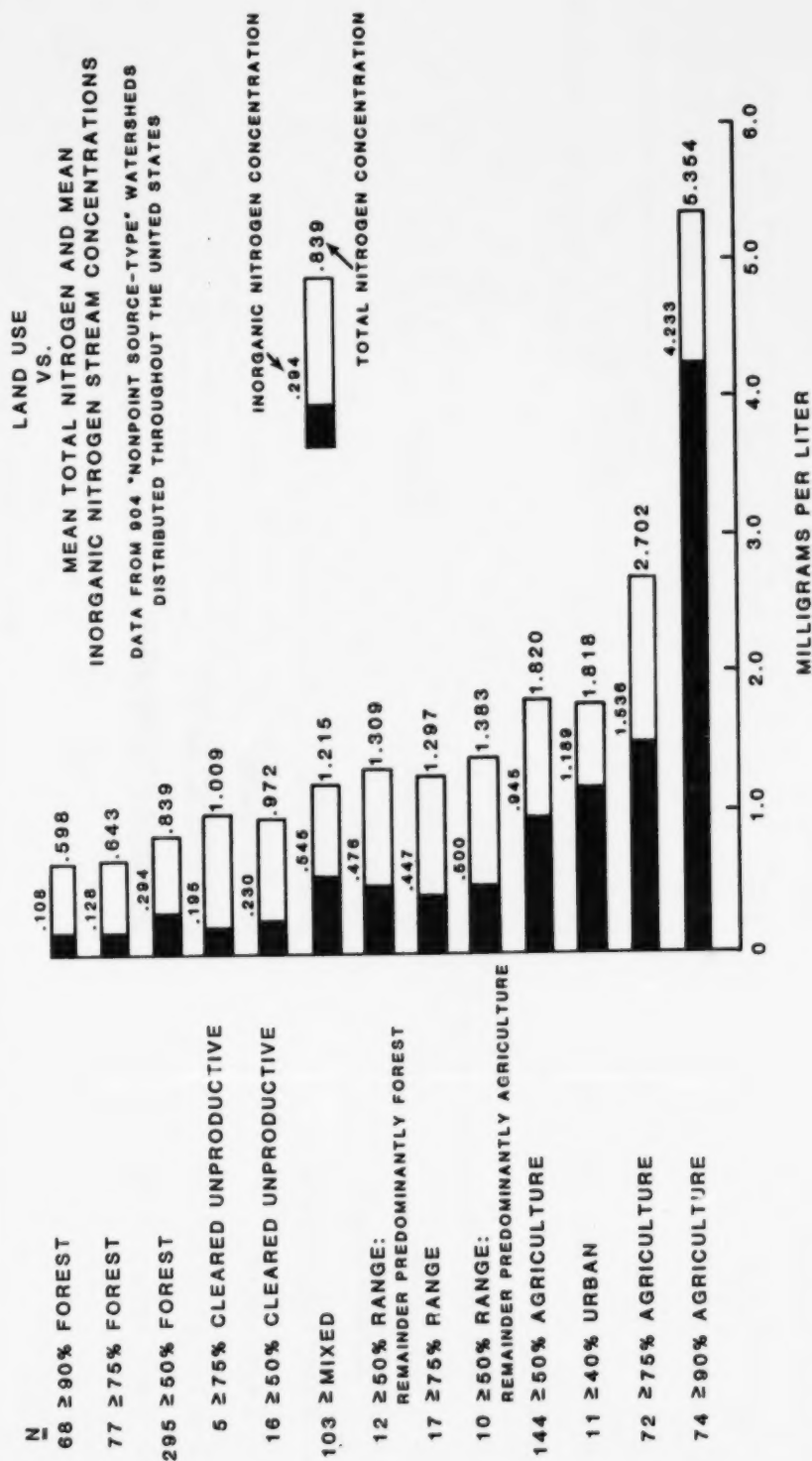


Figure C1-5. Relationships between general land use and total nitrogen and inorganic nitrogen concentrations in streams (Omernik, 1977).

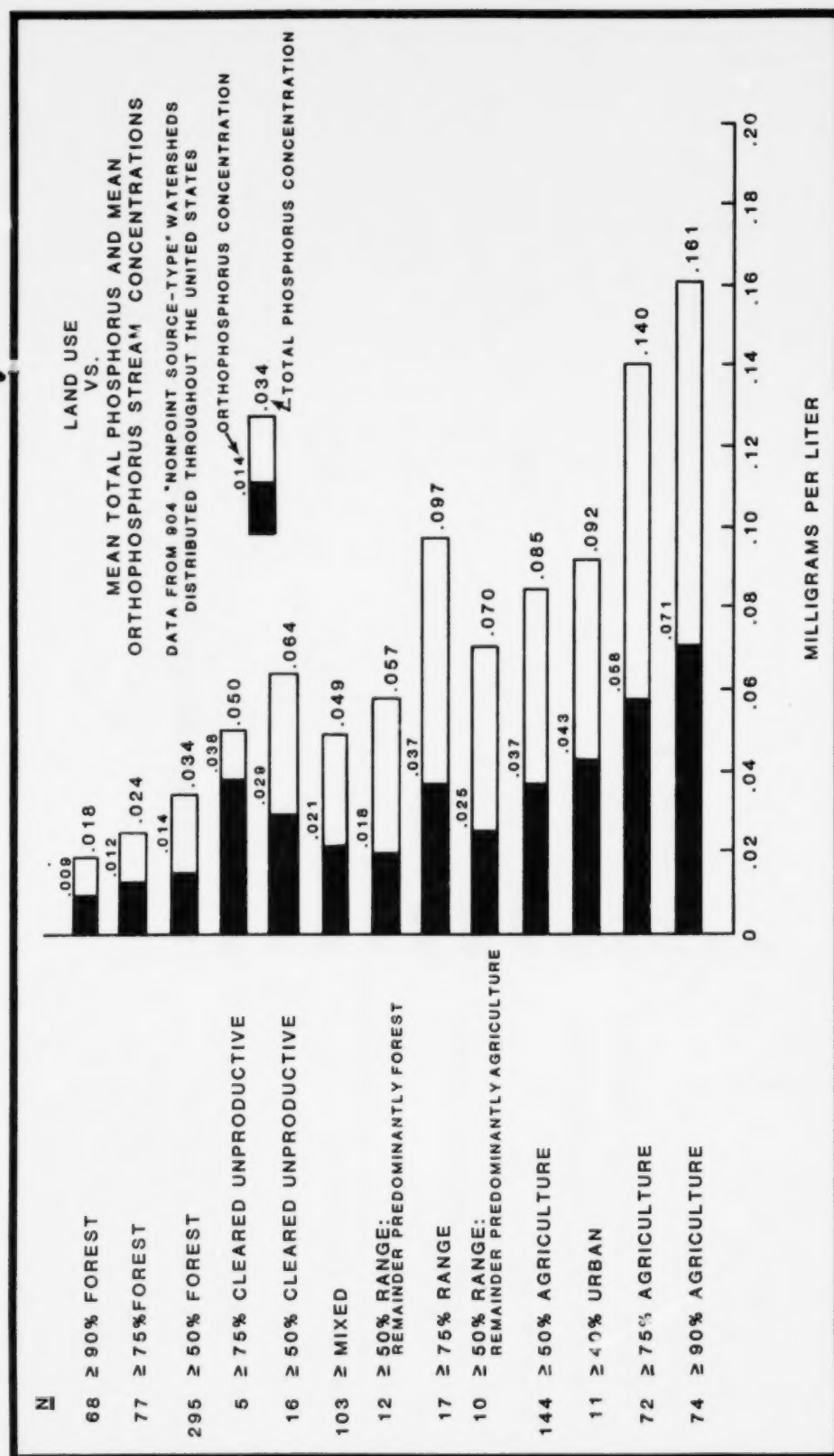


Figure C1-6. Relationships between general land use and total phosphorus and orthophosphorus concentrations in streams (Omernik, 1977).

Urban Storm Water Loads

The best source of information on urban storm runoff loads is the EPA Urban Rainfall Runoff Data Base (Huber, et al. 1979). Quality data are available for the eight cities shown in Figure C1-7. These data are collected at very frequent, e.g., 5- or 10-minute intervals to evaluate intrastorm pollutant transport. The sampling procedures were not set up primarily to estimate long term loads of interest in lake eutrophication studies.

EPA's National Urban Runoff Program is conducting extensive sampling in thirty cities throughout the United States (see Figure C1-8). Further information regarding these ongoing studies can be obtained from EPA Regional Offices or from quarterly progress reports published by EPA's Office of Water and Waste Management, Washington, D.C.

Smolenyak (1979) has performed a detailed analysis of the EPA Urban Rainfall Runoff Data Base. The general procedure he adopted was based on the Rendon-Herrero model (Equation C1-1), which has proved to be a good predictive equation for suspended solids, in sediment transport studies. The key to successful application of this model is the utilization of storm event averages, rather than instantaneous meas-

ured values. Smolenyak concluded that a single rating curve model provided good estimates of the relation of nutrient loads to *storm event* runoff volumes. His results are presented in Table C1-1. The rows for total nitrogen (NTOT) and total phosphorus (TOP) are underlined. Each data point is a *storm event* total for an urban catchment. The equation for total nitrogen is:

$$\text{NTOT} = 0.0400 (\text{FLOW})^{0.71} \quad (\text{C1-2})$$

where NTOT = nitrogen load per storm event (lbs/acre)

FLOW = urban runoff event volume (inches)

The exponent is less than 1, indicating that load increases at a decreasing rate as flow increases. Similar results were found for phosphorus. By contrast, total suspended solids (TSS) increase at an increasing rate as flow increases. This type of equation can be used if a continuous simulation is desired.

A relatively crude model for estimating urban loads for three land uses located in storm and combined sewer areas was developed as part of a national assessment (Heaney, et al. 1977). These estimates are based on data available through 1975. If annual pollutant loads are assumed to vary as a function of population densi-

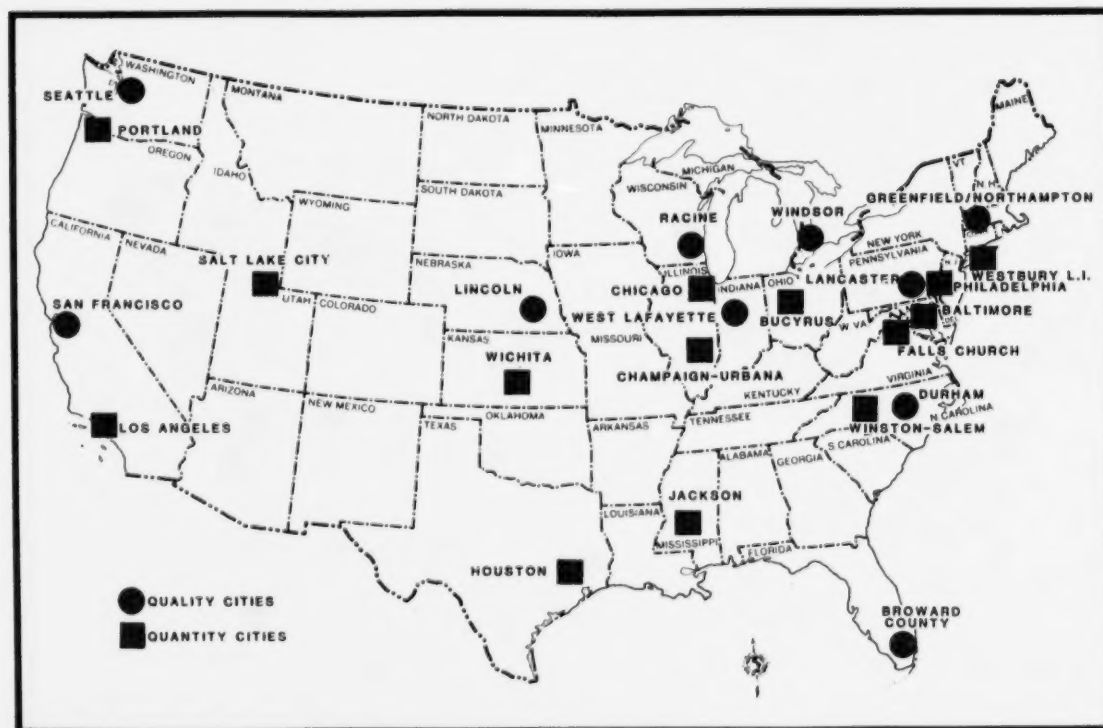


Figure C1-7. Location map for cities with rainfall-runoff-quality data (quality cities) and rainfall-runoff data (quantity cities) (Huber, et al. 1979).

ty, precipitation, land use, and type of sewer system, the following relationship may be used:

$$m_w = \beta(i,j) \cdot P \cdot f_i(PD_d) \text{ for combined sewer areas, (C1-3)}$$

and

$$m_w = \alpha(i,j) \cdot P \cdot f_i(PD_d) \text{ for storm and unsewered areas (C1-4)}$$

where

m_w = annual wet weather pollutant load, lb/ac/yr;

P = annual precipitation, in/yr;

$f_i(PD_d)$ = population density function for land use i (persons/acre);

$\alpha(i,j)$ = coefficient for storm and unsewered areas for pollutant j on land use i , lb/ac/yr/in; and

$\beta(i,j)$ = coefficient for combined sewer areas for pollutant j on land use i , lb/ac/yr/in.

Table C1-1
Relationships Between Pollutant Loads and Flow Volume (Flow) Developed Using All of the EPA Urban Rainfall — Runoff Data Base

Dependent Variable, m	R ²	Sig. Level F-Test	No. of Events	Model Load = a(FLOW) ^b Reg. Coef.	
				a	b
BOD	.28	.99	80	34.0	1.12
COD	.76	.99	157	29.8	1.08
NH3N	.44	.99	20	.215	.72
NITN	.80	.99	21	.119	.80
NTOT	.57	.99	103	.0400	.71
ORGN	.88	.99	40	.856	1.04
TOTN	.74	.99	37	.304	1.07
DOP	.83	.99	34	.0648	.98
TOP	.46	.99	119	.0104	.78
TOTOP	.27	.90	11	.0800	.55
TOTP	.66	.99	53	.426	1.5
TPHOS	.91	.99	8	.105	1.05
TOTS	.69	.99	41	279.0	1.41
TSS	.56	.99	260	44.2	1.10

Source: Smolensky (1979)

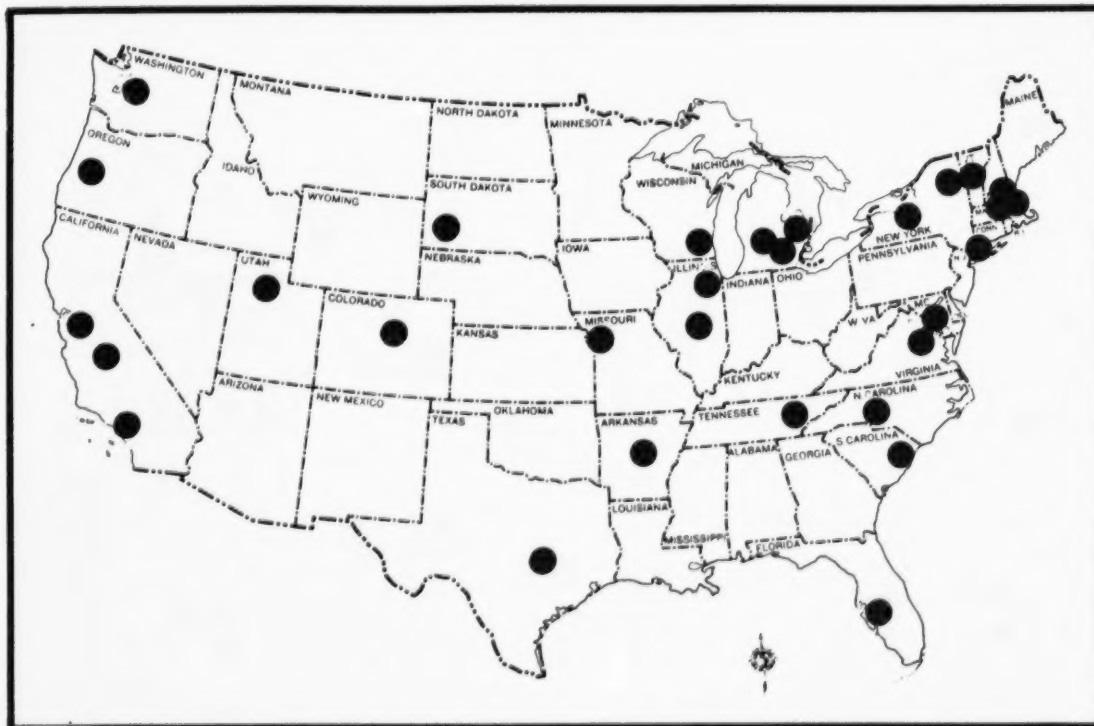


Figure C1-8. Location of NURP Prototype Projects (Woodward-Clyde, 1980).

Table C1-2
Urban Pollutant Loading Factors as a Function of Land Use

Land Uses:	i = 1	Residential
	i = 2	Commercial
	i = 3	Industrial
	i = 4	Other (assume $PD_o = 0$)
Pollutants:	j = 1	BOD ₅ Total
	j = 2	Suspended Solids (SS)
	j = 3	Volatile Solids, Total (VS)
	j = 4	Total PO ₄ (as PO ₄)
	j = 5	Total N
Population Function:	i = 1	$f_i(PD_o) = 0.142 + 0.218 \cdot PD_o^{.54}$
	i = 2,3	$f_i(PD_o) = 1.0$
	i = 4	$f_i(PD_o) = 0.142$

α and β Factors for Equations: Storm factors, α , and combined factors, β , have units lb/ac/yr/in.

		Pollutant				
		BOD ₅	SS	VS	PO ₄	N
Storm Areas, α	1. Residential	0.799	16.3	9.45	0.0336	0.131
	2. Commercial	3.20	22.2	14.0	0.0757	0.296
	3. Industrial	1.21	29.1	14.3	0.0705	0.277
	4. Other	0.113	2.70	2.6	0.00994	0.0605
Combined Areas, β	1. Residential	3.29	67.2	38.9	0.139	0.540
	2. Commercial	13.2	91.8	57.9	0.312	1.22
	3. Industrial	5.00	120.0	59.2	0.291	1.14
	4. Other	0.467	11.1	10.8	0.0411	0.250

Source: Heany, et al. (1977)

Values of $\alpha(i,j)$, and $\beta(i,j)$ and $f_i(PD)$ are shown in Table C1-2.

This method should only be used for a first approximation. As an example, the annual nitrogen load per acre for a residential area (population density = 10 persons/acre) served by storm sewers and receiving 30 inches per year of precipitation is:

$$m_w = \alpha(1,5) (P) (.142 + .218 PD_o^{.54})$$

$$= 0.131 (30) (.142 + .218 (10)^{.54})$$

$m_w = 3.53$ lb/acre/yr. Since 1 lb = .454 kg and 1 acre = .4047 ha, the load in metric units is 3.96 kg/ha/yr, about 20 percent less than Reckhow's estimate.

Agriculture and Precipitation

In addition to Omernik (1977), the Agricultural Research Service(1975) presents summary information on nutrient concentrations. The results are shown in Figure C1-9.

General Estimates

Estimates of annual nutrient loads made to support planning activities conducted under the 208 Program are shown in Table C1-3 (U.S. EPA, 1976c). These data are not as good as the later studies.

Table C1-3
Nonpoint Source and Urban Stormwater Emission Rates (lb/acre/yr)

	Forest	Range	Irrigation in Western U.S.			Cropland Tile Drainage	Urban	3 Dwelling Units/Acre Sewage		
			Active Cropland	Surface Drainage	Sub-Surface Drainage			Treated*	Untreated	Construction
COD	-	-	-	-	-	-	196-276	240.0	1,598.1	-
BOD	-	-	-	-	-	-	27-45	95.9	639.3	-
NO ₃ -N	.62-7.8	.62	-	-	74	-	-	63.4	0.0	-
Total N	2.7-11.6	-	.09-11.6	2.7-24	37.4-166	.27-11.6	6.2-8	63.4	127.8	-
Total P	.027-.27	.07	.05-2.6	.89-3.92	2.7-8.9	.009-.26	.98-5.0	12.8	31.9	-
Sediment	~75	~750	~15,000	-	-	-	~16,000	31.9	213.1	3,000-375,000

*Standard Secondary Treatment, 80% P Removal, 85% BOD Removal, 50% Nitrification.
Hyphen (-) means data unavailable.

Source: U.S. EPA, (1976c)

Nutrient Loads as a Function of Erosion Rates

The Universal Soil Loss Equation is based on a far better data base than presently exists for nitrogen and phosphorus. Thus procedures have been developed to estimate nutrient loads as a function of erosion rates predicted by the Universal Soil Loss Equation (McElroy, et al. 1976). Davis and Nebgen in Loehr, et al. (1979) describe how to use the "nonpoint calculator." The procedure is too detailed to present here. The interested reader is referred to the reference for specific details. More recent estimates of nutrient enrichment ratios are presented in Zison (1980).

Effect of Drainage Sub-Basin Size on Sediment or Nutrient Export

Drainage sub-basin size has a significant impact on the annual flux of nutrients for a drainage sub-basin. Because of lack of data, good results are not available directly for nitrogen and phosphorus. However, estimates are available for erosion as shown in Table C1-4.

This areal scaling factor is needed as part of the USLE because the loading data are all derived from small field level farm plots of the same size. By contrast, the loads reported in the eutrophication literature are for a wide variety of catchment sizes. Table C1-4 can be used in the absence of other data to scale direct nutrient loading information up or down depending on relative catchment sizes.

As an illustration of the effect of scale, the drainage area loads of N and P are significantly less than the field level studies (see Table 4-2).

Table C1-4
Delivery Ratios for Various-Sized Drainage Sub-Basins

Drainage Area (ha)	Delivery Ratio
2.43	.65
4.05	.60
13.0	.50
46.6	.40
259	.30
1,300	.22
13,000	.12
51,800	.03

Source: McElroy, et al. (1976)

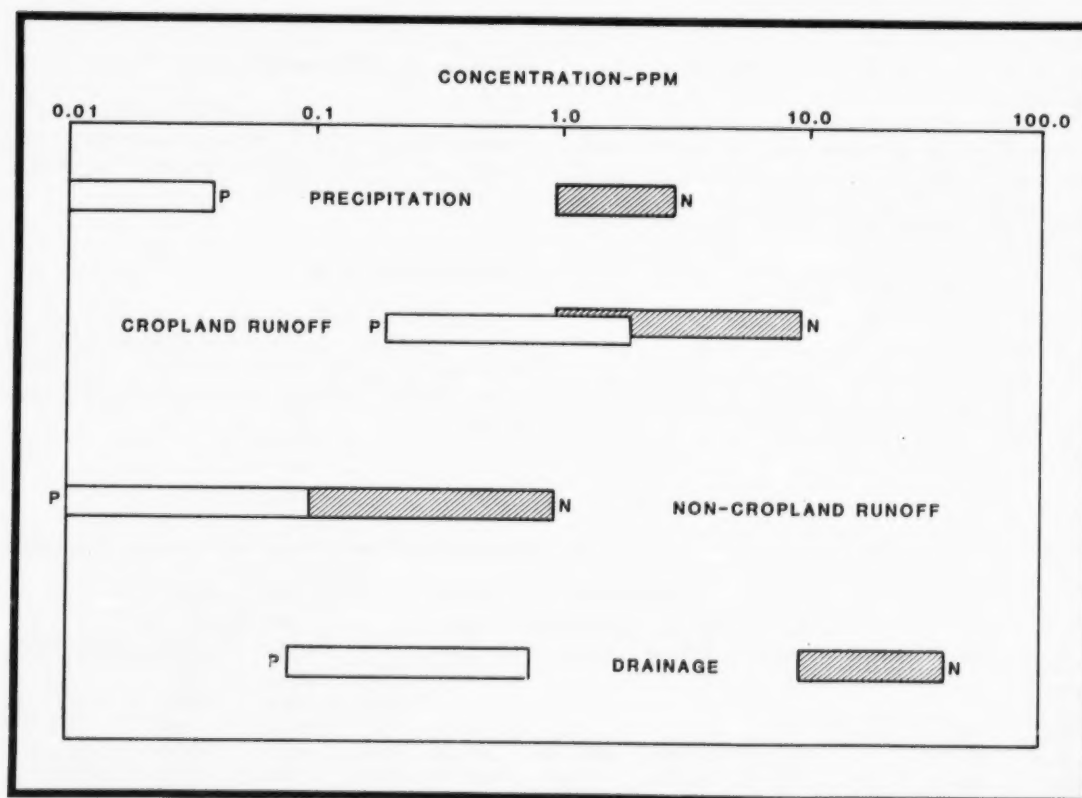


Figure C1-9. Range of Nitrogen and Phosphorus Concentrations in Different Waters (Agricultural Research Service, 1975).

Simulation Models to Estimate Nutrient Fluxes

The information presented thus far provides a basis for making an estimate of the steady state nutrient flux to a lake. If a few years of data are available it may be desirable to use a continuous simulation model to estimate the seasonal variability in nutrient fluxes. Several of the models shown in Figure C1-10 may be used (Huber and Heaney, 1979). The table indicates which models are appropriate for which problems.

Summary

A summary of currently available literature values for estimating annual nutrient flux (load or concentration) to a lake have been presented for a variety of land uses. The importance of properly using concentration and flow data to

estimate total annual fluxes has been stressed. Also, the hydraulic detention time of the lake should be used to obtain a rough idea of the length of the study period needed to estimate fluxes over a cycle. While the available data base is growing rapidly, the need for local calibration data is stressed in order to meaningfully evaluate site specific influences.

Utilization of continuous simulation models will add to the complexity of the study effort, but may provide the most effective way of estimating pollutant fluxes to lakes where averaging periods of considerably less than a year are required. This may be necessary where the water quality problem being addressed has a short characteristic response time to input loads. Examples of such problems include violations of California standards which cause beach closure, and lake Dissolved Oxygen responses to soluble BOD loads.

C2 WATERSHED MANAGEMENT PRACTICES

The observation was made in Section 4.0 of this manual that selecting effective control techniques or management practices will be a highly site-specific task. General groupings of practices can be made, according to the nature of the nonpoint source or activity. Although there will be a degree of similarity (in erosion control measures, for example), the particular form which a control measure takes will tend to be quite different in application in forested, agricultural, and urban watersheds. Some measures are unique to a particular type of nonpoint source (street sweeping for urban areas; contour plowing for cropland). For this reason, each of the major nonpoint sources of pollutant loads, as delineated in Section 4.0, is discussed separately here. Control approaches that have been considered or applied are listed; but, because of the degree of site-specificity, no recommendations can be made. Additional details on applicability, cost, and performance of individual control measures should be obtained from the references cited in this manual. Details on cost and performance are beyond the scope of a manual of this type, but, more importantly, the body of information on these aspects is growing rapidly at this time. Results from individual studies and broader programs now in progress (NURP, Clean Lakes, 208 studies, etc.) are expected to add significantly to our information base over the next few years.

Silviculture

Control techniques can be classified as procedural, preventive, or mitigative. Procedural controls relate to administrative actions: for example, evaluating alternative ways in which a particular silvicultural activity may be carried out, in terms of water quality effects. Preventive controls apply to decisions on details of how to implement activities so that pollutant export will be minimized: for example, access roads and trails may be rated to leave buffer strips along streams, or avoid grades with high erosive potential. Mitigative controls are physical, chemical, or vegetative measures applied to ameliorate problems that exist at present, or will result even after full advantage is taken of procedural and preventive measures: for example, careful design and construction of stream crossings (Currier, et al. 1974; Loehr, et al. 1979).

Of all nonpoint sources, silvicultural activities are among those most controllable by procedural and preventive actions, principally because of the fact that only a small percentage of a forested area is affected at any one time, and activities are moved successively to different areas from time to time. Further, many of the preventive activities are common sense, "good house-keeping" type actions or decisions that can be put into effect without an undue burden on technical or economic resources of the forester.

MODEL NAME	APPLICABLE LAND AREA	TEM- PORAL PROP- ERTIES	SPE- CIAL PROP.	HYDROLOGY	HYDRAULICS	QUALITY PROCESSES	RESIDUALS
URBAN							
AGRICULTURE							
FORESTS							
WETLANDS							
SINGLE STORM EVENTS							
CONTINUOUS STIMULATION							
ANNUAL OR SEASONAL AVERAGE							
SINGLE CATCHMENT							
MULTIPLE CATCHMENTS							
SURFACE/TOTAL HYDROGRAPH GENERATION							
SUB-SURFACE PROCESSES							
SNOWMELT							
DRY-WEATHER/BASE FLOW							
FLOW ROUTING IN CHANNELS/PIPES							
BACKWATER, SURCHARGING, PRESSURE FLOW							
STORAGE/RESERVOIR ROUTING							
SURFACE GENERATION							
ROUTING IN CHANNELS/PIPES							
SEDIMENT/EROSION							
SCOUR/DEPOSITION IN CHANNELS/PIPES							
PARAMETER INTERACTION							
SOIL-SEDIMENT-PARAMETER INTERACTION							
ROUTING THROUGH STORAGES							
TREATMENT REMOVAL IN STORAGES							
TREATMENT PROCESSES							
ORGANIC/BOD/COD							
NITROGEN SPECIES							
PHOSPHORUS							
SUSPENDED SOLIDS							
COLIFORMS							
PESTICIDES							
ARBITRARY OR OTHER CONSERVATIVE							
ARBITRARY OR OTHER NON-CONSERVATIVE							
ECONOMIC ANALYSIS							
HYDROSCIENCE							
MRI							
SWMM-LEVEL I							
EPARBS							
SIMPL. SWMM							
ACTMO							
ARM							
HSP							
NPS							
QOS							
STORM							
AGRUM							
CARELAS							
SWMM							

Figure C1-10. Applicability of Runoff Models to Various Problem Contexts (Huber and Heany, 1980).

Specific silvicultural activities that increase erosion potential, and for which control practices can be applied, are described briefly here. Table C2-1 summarizes a set of management practices by Forestry from the State of Virginia's Best Management Practices Handbook, and a qualitative rating of feasibility and control effectiveness. Applicable BMP numbers are identified with each of the activities in the description below.

Roads and trails. Construction, use, and maintenance of access roads and skid trails (for moving logs from stump area to loading station) expose the ground surface to erosion, and can alter drainage patterns in a manner which may intensify erosive forces. Control measures include routing across, rather than up and down slopes, where possible, providing artificial drainage where normal patterns are disrupted seriously, and restricting use during adverse weather periods.

Applicable BMPs (from Table C2-1): D1, D2, D3, D18, D19.

Timber harvest. Harvesting of timber increases erosion potential in cleared area by removing forest canopy and exposing ground surface to energy by rainfall, by disturbing ground surface, and by increasing runoff due to reduced evapotranspiration. Removal of trees adjacent to streams can increase water temperature because shading is eliminated. Control measures include leaving buffer strips near streams, prompt reseeding of area, and runoff diversion or impoundment in critical areas.

Applicable BMPs: D7, D8, D11, D15, D17, D18.

Reforestation. Preparation of a site for replanting will include combinations of the following activities that tend to increase erosivity. *Chop*, or *chop and burn* activities involve the felling of remaining noncommercial trees. Material is often burned to further clear the site. *Shear and windrow* activities prepare the ground for replanting by cutting off residual vegetation at the ground surface, and piling the material in rows, leaving intervening ground clear. Heavy equipment is usually employed in these operations, and residual material is often burned.

Applicable BMPs: D4, D5, D12, D13, D14, D16, D17, D18.

Burning. This is sometimes used as a management tool and increases erosion potential by exposing ground surface. The mobility of the remaining ash and the minerals it contains may be increased.

Applicable BMP: D10.

Chemical application. Intensive timber management sometimes includes application of fertilizers and pesticides. Forest fertilization of established tree stands is reported to be growing in the Northwest and Southwest (U.S. EPA, 1976a); but in the Northeast, there is no significant use of broadcast fertilizer to encourage tree growth (New England Natural Resources Center, 1977).

Applicable BMP: D6.

Nonsilvicultural activities. Activities that often occur in forested watersheds, and can contribute to pollutant export, but which are not associated with silviculture operations, are recreational activities and grazing. Camping, recreational travel, and fishing and hunting are common in many areas, and can result in problems ranging from waste disposal to site maintenance. Grazing may constitute a major land use within certain timber areas. Pollutant export considerations will be similar to those discussed for agricultural activities.

Applicable BMP: D9.

Agriculture

Agriculture management practices and control measures can be classified according to whether they are primarily directed to control erosion, to reduce runoff, or to manage fertilizers or pesticides. This classification scheme was adopted by EPA/USDA (1975) in "Control of Water Pollution from Cropland," which discusses nonpoint source loads and their control in detail.

Management practices applicable to the control of agricultural loads are summarized in Tables C2-2 through C2-5, drawn from this source, and organized according to this classification.

Important interrelationships exist among the groups and, in individual cases, may affect the choice of a practice. For example, some erosion control practices may result in increased chemical usage to control crop pests. Ultimate selection, therefore, will require an appropriate balancing of effects.

Erosion Control. In many situations, erosion can be controlled with *agronomic practices* that improve crop residue management, cropping sequences, seeding methods, soil treatments, tillage methods, and timing of field operations. Generally, farming parallel to the field contours will further reduce erosion. However, contouring and some of the agronomic control practices are not sufficient where slope length or the area from which runoff concentrates is excessive. They must then be *supported* by practices such as terraces, diversions, contour furrows, contour listing, contour strip cropping, waterways, and control structures.

Table C2-2 lists the principal types of erosion control practices and some of their favorable and unfavorable features. Under many conditions, it may be necessary to apply various combinations of these practices. Modifications of specific practices within these general types affect their adaptability and also their effectiveness.

Runoff Control. Surface runoff from cropland can rarely be eliminated. However, it can be substantially affected by agronomic and engineering practices. Land use and treatment can affect direct runoff in two ways: (1) change the volume of runoff, and (2) change the peak rate of runoff.

Table C2-1
Best Management Practices for Forestry

BMP Number	Description	Applicability and Ease of Implementation	Nutrient Control	Sediment Control
D1	Woodland Access Roads and Trails Design of access roads and trails to minimize erosion and runoff.	High	High	High
D2	Road Use Regulating, reducing, or eliminating traffic on haul roads during unfavorable weather to reduce soil erosion.	High	Medium	Medium
D3	Planned Travelways Keeping equipment from crossing streams except at bridges, culverts, and preselected fords.	High	Medium	Medium
D4	Site Preparation Using site preparation methods that minimize erosion and runoff. Methods include prescribed burning, mechanical disturbance, chemical treatments, and drainage installations.	High	High	High
D5	Tree Planting Planting of trees using methods that minimize erosion and runoff.	High	High	High
D6	Pesticide Application Designing pesticide application to minimize pesticide runoff.	Medium	Low	Low
D7	Forest Harvesting Design a harvesting system that minimizes erosion and runoff.	High	High	High
D8	Revegetation Planting vegetables such as grasses and legumes on critical areas to stabilize the soil and reduce erosion and runoff.	High	High	High
D9	Forest Recreation Designing forest recreational facilities to minimize erosion and runoff.	Low	Medium	Medium
D10	Wildfire Control and Reclamation Using wildfire control and reclamation procedures that minimize water pollution problems.	Medium	Medium	Medium
D11	Filter Strips Using a barrier of perennial vegetation to filter runoff.	High	High	High
D12	Brush Management Killing, suppressing, or managing brush by mechanical, chemical, or biological means.	Medium	Medium	Medium
D13	Disposal of Slash Keeping logging debris out of streambeds during cutting operation.	High	Medium	Medium
D14	Critical Area Planting Planting vegetation such as trees, shrubs, vines, and grasses on critical erosion areas.	High	High	High
D15	Open Stack Storage, Piles, and Composting Storing forest products and residues in such a manner as to minimize water pollutions.	Medium	Medium	Medium
D16	Contour Plowing and Planting Following contours when using soil-distributing equipment or when planting trees.	High	High	High
D17	Terrace Using an earth embankment or channel across a slope to control runoff.	High	Medium	Medium
D18	Drainage Ditches and Dips Proper location and design of ditches to minimize erosion from runoff.	Medium	High	High
D19	Diversion Using a channel or a bar to divert excess runoff water.	Medium	Medium	Medium
D20	Water Impoundment Using a basin to provide sediment retention and flood control	Medium	Medium	High

Source: Virginia State Water Control Board. (1979)

Table C2-2
Cropland Erosion Control Practices

No.	Erosion Control Practice	Practice Highlights
E1	No-till planting in prior crop residues	Most effective in dormant grass or small grain; highly effective in crop residues; minimizes spring sediment surges and provides year-round control; reduces man, machine, and fuel requirements; delays soil warming and drying; requires more pesticides and nitrogen; limits fertilizer and pesticide placement options; some climatic and soil restrictions.
E2	Conservation tillage	Includes a variety of no-plow systems that retain some of the residues on the surface; more widely adaptable but somewhat less effective than E1; advantages and disadvantages generally same as E1 but to lesser degree.
E3	Sod-based rotations	Good meadows lose virtually no soil and reduce erosion from succeeding crops; total soil loss greatly reduced but losses unequally distributed over rotation cycle; aid in control of some diseases and pests; more fertilizer-placement options; less realized income from hay years; greater potential transport of water soluble P; some climatic restrictions.
E4	Meadowless rotations	Aid in disease and pest control; may provide more continuous soil protection than one-crop systems; much less effective than E3.
E5	Winter cover crops	Reduce winter erosion where corn stover has been removed and after low-residue crops; provide good base for slot-planting next crop; usually no advantage over heavy cover of chopped stalks of straw; may reduce leaching of nitrate; water use by winter cover may reduce yield of cash crop.
E6	Improved soil fertility	Can substantially reduce erosion hazards as well as increase crop yields.
E7	Timing of field operations	Fall plowing facilitates more timely planting in wet springs, but it greatly increases winter and early spring erosion hazards; optimum timing of spring operations can reduce erosion and increase yields.
E8	Plow-plant systems	Rough, cloddy surface increases infiltration and reduces erosion; much less effective than E1 and E2 when long rain periods occur; seedling stands may be poor when moisture conditions are less than optimum. Mulch effect is lost by plowing.
E9	Contouring	Can reduce average soil loss by 50% on moderate slopes, but less on steep slopes; loses effectiveness if rows break over; must be supported by terraces on long slopes; soil, climatic, and topographic limitations; not compatible with use of large farming equipment on many topographies. Does not affect fertilizer and pesticide rates.
E10	Graded rows	Similar to contouring but less susceptible to row breakovers.
E11	Contour strip cropping	Rowcrop and hay in alternate 50- to 100-foot strips reduce soil loss to about 50% of that with the same rotation contoured only; fall seeded grain in lieu of meadow about half as effective; alternating corn and spring grain not effective; area must be suitable for across-slope farming and establishment of rotation meadows; favorable and unfavorable features similar to E3 and E9.
E12	Terraces	Support contouring and agronomic practices by reducing effective slope length and runoff concentration; reduce erosion and conserve soil moisture; facilitate more intensive cropping; conventional gradient terraces often incompatible with use of large equipment, but new designs have alleviated this problem; substantial initial cost and some maintenance costs.
E13	Grassed outlets	Facilitate drainage of graded rows and terrace channels with minimal erosion; involve establishment and maintenance costs and may interfere with use of large implements.
E14	Ridge planting	Earlier warming and drying of row zone; reduces erosion by concentrating runoff flow in mulch-covered furrows; most effective when rows are across slope.
E15	Contour listing	Minimizes row breakover; can reduce annual soil loss by 50%; loses effectiveness with post-emergence corn cultivation; disadvantages same as E9.
E16	Change in land use	Sometimes the only solution. Well managed permanent grass or woodland effective where other control practices are inadequate; lost acreage can be compensated for by more intensive use of less erodible land.
E17	Other practices	Contour furrows, diversions, subsurface drainage, land forming, closer row spacing, etc.

Direct surface runoff volumes can be reduced by measures that: (1) increase infiltration rates; (2) increase surface retention storage, allowing more time for water to infiltrate into the soil; and (3) increase interception of rainfall by growing plants or residues.

Peak runoff rates can be decreased by treatments that increase the hydraulic resistance of the surface, decrease the land slope, or increase the length of flow path. Such practices will also generally reduce erosion.

How much direct runoff can be reduced depends on the number and type of control measures used and on the characteristics of the soils and climate of the particular location. Runoff control measures and their highlights are summarized in Table C2-3.

Nutrient Control. Nutrients are moved from agricultural land by leaching, direct runoff, and in association with sediment from erosion. A number of practices will reduce direct runoff and/or erosion and, thus, reduce nutrient trans-

port. These practices will usually be adequate for controlling overland nutrient transport in addition to sediment and pesticide transport. However, in some cases, such as leaching, additional and/or alternative practices will have to be used to achieve the desired degree of control. These involve changing the use of nutrients. A list of these practices and their highlights is given in Table C2-4.

Pesticide Control. Clearly, reducing runoff or erosion will also reduce loss of applied pesticides, and practices that control runoff and erosion should always be considered in pesticide pollution control. In addition to these practices, a number of options exist, and are often used, involving manipulation of the pesticide itself. These can be used alone or in conjunction with the runoff and erosion control measures. Table C2-5 lists 15 such practices divided into two groups based on their applicability.

Obviously, good basic management of the chemicals should be practiced wherever pesti-

Table C2-3
Runoff Control Practices

No.	Runoff Control Practice	Practice Highlights
R1	No-till planting in prior crop residues	Variable effect on direct runoff range from increases (on soils subject to compaction) to substantial reductions.
R2	Conservation tillage	Slight to substantial runoff reduction.
R3	Sod-based rotations	Substantial runoff reduction in sod year; slight to moderate reduction in rowcrop year.
R4	Meadowless rotations	None to slight runoff reduction.
R5	Winter cover crop	Slight runoff increase to moderate reduction.
R6	Improved soil fertility	Slight to substantial runoff reduction depending on existing fertility level.
R7	Timing of field operations	Slight runoff reduction.
R8	Plow-plant systems	Moderate runoff reduction.
R9	Contouring	Slight to moderate runoff reduction.
R10	Graded rows	Slight to moderate runoff reduction.
R11	Contour strip cropping	Moderate to substantial runoff reduction.
R12	Terraces	Slight increase to substantial runoff reduction.
R13	Grassed outlets	Slight runoff reduction.
R14	Ridge planting	Slight to substantial runoff reduction.
R15	Contour listing	Moderate to substantial runoff reduction.
R16	Change in land use	Moderate to substantial runoff reduction.
R17	Other practices: Contour furrows Diversion Drainage Landforming	Moderate to substantial reduction. No runoff reduction. Increase to substantial decrease in surface runoff. Increase to slight runoff reduction.
R18	Construction of ponds	None to substantial runoff reduction. Relatively expensive. Good pond sites must be available. May be considered as a treatment device.

cides are used, whether or not runoff control measures are necessary. Pesticides should always be used strictly in accordance with instructions on their labels; to do otherwise is illegal. The chemicals should be stored so as to minimize the hazard of possible leakage, and containers should be disposed of after use in accordance with accepted procedures.

Urban Runoff

Although there is some overlap, control measures differ for combined sewer overflows (CSO), and for urban runoff from storm sewers in an area where sanitary sewage is conveyed by a separate collection system. This distinction is useful because the analyst will normally find it desirable to consider both load estimation and evaluation of management opportunities from each of these areas independently. It has been

noted (Chapter 4) that the magnitude of pollutant loads is distinctly different for each; additionally, the institutional approaches for management will usually be sufficiently different to warrant separate consideration.

Urban runoff controls which have been proposed, tested, or actually installed tend to be more oriented toward structural measures than is the case for other nonpoint sources. Separate lists of typical management practices are provided for CSOs and for separate storm sewers. The user should recognize that, despite the category to which a control measure is assigned in the lists, many are potentially applicable in either category. The practices tend, however, to be more practical or cost-effective in the category of urban load in which they appear. Street sweeping, for example, could be practiced in a CSO area. However, since diluted raw sewage tends to contribute most of the pollutants discharged

Table C2-4
Nutrient Loss Control Practices

No.	Nutrient Control Practice	Practice Highlights
N1	Eliminating excessive fertilization	May cut nitrate leaching appreciably, reduces fertilizer costs; has no effect on yield.
Leaching Control		
N2	Timing nitrogen application	Reduces nitrate leaching; increases nitrogen use efficiency; ideal timing may be less convenient.
N3	Using crop rotations	Substantially reduces nutrient inputs; not compatible with many farm enterprises; reduces erosion and pesticide use.
N4	Using animal wastes for fertilizer	Economic gain for some farm enterprises; slow release of nutrients; spreading problems.
N5	Plowing under green legume crops	Reduces use of nitrogen fertilizer; not always feasible.
N6	Using winter cover crops	Uses nitrate and reduces percolation; not applicable in some regions; reduces winter erosion.
N7	Controlling fertilizer release or transformation	May decrease nitrate leaching; usually not economically feasible; needs additional research and formation development.
Control of Nutrients in Runoff		
N8	Incorporating surface applications	Decreases nutrients in runoff; no yield effects; not always possible; adds costs in some cases.
N9	Controlling surface applications	Useful when incorporation is not feasible.
N10	Using legumes in haylands and pastures	Replaces nitrogen fertilizer; limited applicability; difficult to manage.
Control of Nutrient Loss by Erosion		
N11	Timing fertilizer plow-down	Reduces erosion and nutrient loss; may be less convenient.

from CSOs, it would be expected that street sweeping would be less effective in a CSO area than in a separately sewered area where street surfaces provide a major component of the pollutant loads. Exceptions exist, as in the case where a particular pollutant (say, lead from vehicular traffic) originating on street surfaces is of concern. A similar rationale can be applied in evaluating the other measures listed.

Structural controls will tend to be more applicable for CSO areas for two reasons. These discharges tend to be more localized, concentrated in a limited number of discharge points at which controls can be placed. Also, the higher loading

rates that they represent tend to make the more costly structural approaches practical to consider.

Combined Sewer Overflows. Combined sewers convey sanitary sewage to sewage treatment plants during dry weather. During storms, they additionally collect stormwater, and to the limit of the hydraulic capacity provided, they carry a mixture of sanitary sewage and stormwater. Stormwater inflows are many times the normal rate of sanitary sewage flows. To avoid flooding, regulators are installed which permit overflows to provide hydraulic relief. A list of control mea-

Table C2-5
Pesticide Loss Control Practices

No.	Pesticide Control Practice	Practice Highlights
Broadly Applicable Practices		
P1	Using alternate pesticides	Applicable to all field crops; can lower aquatic residue levels; can hinder development of target species resistance.
P2	Optimizing pesticide placement with respect to loss	Applicable where effectiveness is maintained; may involve moderate cost.
P3	Using crop rotation	Universally applicable; can reduce pesticide loss significantly; some indirect cost if less profitable crop is planted.
P4	Using resistant crop varieties	Applicable to a number of crops; can sometimes eliminate need for insecticide and fungicide use; only slight usefulness for weed control.
P5	Optimizing crop planting time	Applicable to many crops; can reduce need for pesticides; moderate cost possibly involved.
P6	Optimizing pesticide formulation	Some commercially available alternatives; can reduce necessary rates of pesticide application.
P7	Using mechanical control methods	Applicable to weed control; will reduce need for chemicals substantially; not economically favorable.
P8	Reducing excessive treatment	Applicable to insect control; refined predictive techniques required.
P9	Optimizing time of day for pesticide application	Universally applicable; can reduce necessary rates of pesticide application.
Practices Having Limited Applicability		
P10	Optimizing date of pesticide application	Applicable only when pest control is not adversely affected; little or no cost involved.
P11	Using integrated control	Effective pest control with reduction in amount of pesticide used; program development difficult.
P12	Using biological control methods	Very successful in a few cases; can reduce insecticide and herbicide use appreciably.
P13	Using lower pesticide application rates	Can be used only where authorized; some monetary savings.
P14	Managing aerial applications	Can reduce contamination of nontarget areas.
P15	Planting between rows in minimum tillage	Applicable only to row crops in nonplow-based tillage; may reduce amounts of pesticides necessary.

tures suitable for such discharges is presented in Table C2-6.

In many cases, the condition of these regulators will warrant careful attention. Poor maintenance can often result in discharges even during dry weather. In addition, regulator settings will often have been made in the past to minimize the potential for upstream flooding, and to reduce the hydraulic load reaching the treatment plant. An appreciable reduction in overflow loads may be possible by adjusting the regulators to increase the combined sewage routed to the treatment plant.

Descriptions of control measures listed in Table C2-6, and information on cost and performance are provided in a number of references (for example, A Statistical Method for Assess-

ment of Urban Stormwater — EPA 1979; U.S. EPA 1976a).

Separate Storm Runoff. Some types of control measures which have been considered for management of separate storm runoff are listed in Table C2-7. Urbanizing and newly developing areas may be more amenable to the imposition of controls than will be the older, developed areas. Physical constraints such as available space and competing land use will be less of a factor in newly urbanizing areas, and existing ordinances dealing with construction, runoff, and erosion control will often be adaptable to water quality purposes.

EPA's National Urban Runoff Program is investigating cost and performance of a variety of control measures for runoff from separate storm sewers (Woodward-Clyde, 1980).

Table C2-6
Combined Sewer Overflow Practices

STORAGE BASINS	— intercept and retain CSOs for return to sewers during dry periods, or equalize flows for more efficient treatment prior to discharge.
SEDIMENTATION	— provides gravity settling of suspended solids. Chemical coagulation may be employed to enhance removal efficiency.
DISSOLVED AIR FLOTATION	— separates solids by flotation and surface skimming. Uses less area than sedimentation. Chemical coagulation may be used.
SWIRL CONCENTRATOR	— developed for CSO applications; compact device; separates settleable solids and floatable material.
HELICAL BEND SEPARATOR	— developed for CSO applications; provides solids separation; installed in line; low head loss.
SCREENS AND MICROSCREENS	— remove particles by straining; wide range of apertures from several inch openings to very fine mesh (23 micron). Finer screening devices are mechanical.
DISINFECTION	— with chlorine or other agents. Required facilities include chemical feeders, mixing, and contact chambers.
SEWER FLUSHING	— removes solids accumulations which occur at critical points in sewer system in advance of scour during storm runoff.
STREET FLUSHING	— transports street surface contaminants to sewer during dry weather when they will reach treatment plants without overflow.

Table C2-7
Some Separate Storm Runoff Controls

STREET SWEEPING	— includes sweeping of parking lots, to remove accumulations of dust, dirt, and debris.
CATCH BASIN CLEANING	— removal of accumulations on a regular basis to maintain ability to intercept solids.
ELIMINATE CROSS-CONNECTING	— illegal connections of sanitary sewage can significantly increase strength of storm sewage.
PERMEABLE SEWERS AND CATCH BASINS	— in areas with soil of sufficiently high permeability, runoff flow and loads can be attenuated.
DETENTION BASINS	— various types; provide for sedimentation, percolation, or increased evaporation to reduce flows and loads. Flow reductions may help to reduce subsequent erosion.
WETLANDS TREATMENT	— routing storm flows through an area of vegetation in a controlled manner, to remove nutrients, metals, and solids.
PUBLIC EDUCATION AND ORDINANCES	— can reduce runoff loads by reducing litter accumulations, controlling fertilizer applications, eliminating dumping of oil or other objectionable materials.

C3 INSTITUTIONAL

INSTITUTIONAL EVALUATION METHODOLOGY

Suggested procedures for review, evaluation, and selection of an appropriate institutional framework are similar to those for physical controls. The steps in an evaluation procedure are the following:

1. Review of existing watershed institutional/management framework
2. Specify "ideal" institutional arrangements
3. Evaluate existing agencies and organizations for:
 - a. Effectiveness in accomplishing water quality objectives
 - b. Potential for expanded or modified future role
4. Evaluate new and innovative institutional structures
5. Select most "workable" institution(s) for implementation.

These procedures are briefly described below:

Step 1: Review of Existing Institutional/Management Framework

A detailed understanding of the existing institutional/management situation operating within a watershed is a prerequisite to developing recommendations for a new or revised program. Specific information is needed about each agency and organization — whether governmental, quasi-public, or citizen-directed — that is affected by, or potentially affects, water quality management activities.

Prior to gathering detailed data, a preliminary screening process should be followed to eliminate any uninvolved agencies or organizations, thereby reducing the overall scope of work.

Table C3-1 is an example of a standard form used by the State of Nevada in evaluating organizations for runoff and erosion control (Nevada,

1976). Also, it may be helpful to develop a flow chart or otherwise diagram the existing institutional/management framework in the watershed indicating not only the organization but also its functions as they relate to watershed management.

Step 2: Specify "Ideal" Institutional Arrangements

Since the assessment of institutional arrangements is primarily qualitative and no single solution exists for proper watershed management, a set of preferred institutional characteristics should be developed. A list of those characteristics that should be considered is presented in Table C3-2. No single agency is likely to possess all of these characteristics. A more realistic approach would involve a combination of existing, and perhaps new, agencies organized into a comprehensive institutional framework under the desired watershed management objectives.

This list of characteristics should be compared with the results of procedural Steps 3 and 4 to select the most workable strategy in Step 5.

Step 3: Evaluate Existing Agencies and Organizations

Each of the existing agencies and organizations identified in Step 1 should be evaluated for its effectiveness in accomplishing the watershed management program's stated objectives, and its potential for accepting and maintaining an expanded or modified role in future management activities. Such an evaluation is qualitative and subjective at best. An existing program may be regulatory or nonregulatory (voluntary), each requiring a slightly different approach. Examples of program evaluations for sediment and erosion control and runoff and erosion control are presented in Martin and Helm (1980) and

Table C3-1
Standard Form for Summarizing an Organization, Its Areas of Interest,
Authorities, and Programs Relating to Watershed Management

Agency (Organization) Name
Area Office Address
Telephone
Agency Organization (Structure or Hierarchy)
General Type of Activity
Authority and Legislation (in area of water quality management)
Specific Programs Related to Water Quality Management
Agency Views on Specific Problems Identified
Effectiveness of Programs
Controls or Techniques Applying or Responsible for Applying
Manpower and Budget Levels
Deficiencies in Existing Authorities, Manpower, or Budget

Table C3-2
Ideal Characteristics of Watershed
Institutional/Management Arrangements

Provide the earliest control.
Provide long-term self-sustaining and control management.
Factor social and economic considerations into technical implementation.
Require little paper work.
Provide rapid procedures for program operation.
Provide comprehensive monitoring and data collection for adequate management and decision-making.
Provide continuous and rapid analysis and dissemination of data and other watershed program information.
Be flexible in allowing proper application to local situations.
Must be willing to accept institutional responsibilities and act on them.
Provide adequate education of management functions, operations, progress in problem alleviation, and achievement of objectives to watershed residents, users, technical professionals, and elected officials.
Provide baseline levels of control.
Closely approximate existing authorities and program objectives by using existing authorities, if possible; provide for meaningful public participation.
Provide continuing program review, evaluation, and updating.
Be comprehensive in watershed coverage where similar problems exist throughout.
Assure that agencies establish and maintain formal and/or informal coordination and working relationships.
Provide for adequate regulatory authority where voluntary approaches are not successful.
Provide adequate levels of technical assistance in program implementation and monitor progress in lake response.
Accept responsibility for implementing specific control measures, where appropriate.
Provide adequate long-term planning for watershed management.
Provide economic assistance, tax advantages, or other incentives where necessary to achieve implementation.
Provide adequate fiscal management with the objective of minimizing the financial resources required to attain water quality levels.
Must possess sufficient independence to guide in making proper watershed-wide choices.

Nevada (1976), respectively. Ideally, evaluations should be performed both in the field, where the implementation is evident, and in-house; however, resources often will not allow such a detailed analysis. As an alternative, an evaluation team may be organized with representatives from the agency involved, local elected officials, technical professionals, and other individuals from outside the agency including interested citizens and those directly affected by the agency activities, e.g., homebuilders. This evaluation

team can provide insight into agency operations, successes and failures, and results.

Figure C3-1 presents the basic questions to be considered in evaluating an agency's or organization's authority and program. Each institution must be assessed for its powers, capabilities, constraints, and financial status. In its Program Guidance Memorandum SAM-31 (November, 1978), EPA has provided guidance in the necessary elements of a regulatory program that can be helpful in evaluating such a program.

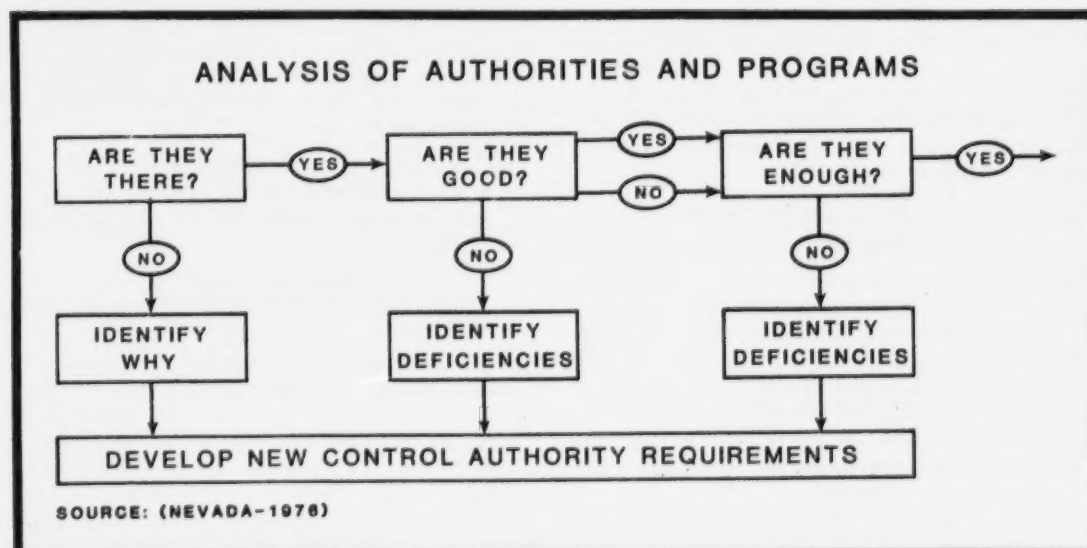


Figure C3-1. Evaluation Analysis of Management Agencies.
Source: Nevada (1976).

Specific points to be considered include:

- Program's effectiveness
- Legal authorities
- Rules and regulations
- Administrative procedures
- Operating procedures
- Resources (budget, staff, training, etc.)
- Management characteristics
- Field implementation, inspection, and enforcement procedures
- Planning
- Program monitoring, evaluation, and revisions
- Education, both technical and public
- Technical implementation problems.

To be successful, the agency must be willing to accept and work toward watershed management objectives, and be capable, through its authorities and programs, to conduct implementation and/or other management activities.

Step 4: Evaluate New and Innovative Institutional Structures

A variety of single and multipurpose institutional agencies and organizations are being tried throughout the country. Examples include the creation of stormwater drainage utilities such as the one in Bellevue, Wash., and Lake Management Districts as in Wisconsin. Other multipurpose, quasi-public community and homeowners associations with technical operations-maintenance personnel may have the potential to carry out certain lake and watershed management responsibilities. A brief discussion of some of these institutions follows in this appendix. The main purpose of this step is for the analyst to become familiar with potential institutions that may be applied in a watershed to manage water quality. EPA's Clean Lakes and 208 Programs have published success stories and new forms of institutional/management frameworks. A major question to ask about these new innovative institutions, their authorities, and programs is, "Are they legal?" (Environmental Law Institute, 1977).

Step 5: Select the Most Workable Institutions for Implementation

When the data gathering and assessment steps (1-4) have been completed, the comparison and selection of the most workable institutions and management structure components can proceed. The following are basic questions that should be asked in the selection and final design of an institutional program:

- Solution strategies recommended for correction or problems?
 - Program revisions
 - New program additions
 - Old program deletions (i.e., what will be done?)

- How will recommended strategies be carried out (description)?
- Where will they be implemented (scope of application)?
- Who will perform them (responsible participants)?
- What will they cost (resource commitments)?
- How will they be paid for (sources of commitments)?
- When will they be carried out (timing or phasing)?
- How will the public be involved and made knowledgeable about the program?
- How will the program be monitored, and who will be responsible for it?
 - Program monitoring for effectiveness and degree of implementation (annual progress reports as a minimum).

Comparison of various alternative structures may be based on the characteristics listed in Step 3 above. However, alternative institutional/management structures will not be generated in all cases. A single, clearly defined framework may evolve during the data gathering and assessment steps. Use of existing institutions, after proper evaluation, is by no means a poor solution if watershed management can be successfully applied.

EXAMPLES OF MANAGEMENT INSTITUTIONS

A classic example of an innovative institution established nationwide over 40 years ago, is the Soil Conservation District (Williams and Lake, 1979). Introduced to the States as model legislation in 1937 by President Franklin Roosevelt, the conservation movement began by creating conservation districts as political subdivisions in most States. Since that time, over 3,000 districts have been created under State law. Although the State laws vary, the purpose of these districts is the same everywhere:

1. To focus on land, water, and related resource problems
2. To develop programs to solve these problems
3. To enlist support and cooperation from all public and private sources to accomplish their goals.

Also of primary importance is the fact that districts are managed by local citizens who know local problems; they are staffed by trained professionals. Local districts are supported technically by the U.S. Department of Agriculture's Soil Conservation Service. If an SCD exists in the watershed under study, it may be an ideal institution to form the basis for a framework to solve agriculture and urban/urbanizing watershed problems.

One innovative concept that has the potential to significantly contribute to watershed management is a stormwater drainage utility. Important pioneering work has been under way in establishing a utility by the City of Bellevue, Washington. Bellevue is a community with a population of 70,000 located on the shore of Lake Washington. To address the significant ecosystem problems that exist, Bellevue established the drainage utility to continuously monitor runoff, work towards a low-impact runoff transport system, and create incentives for applying good management practices in the community. To adequately fund the utility, a small, special-purpose tax was charged to all property owners based on total area owned and population density rather than impervious surface owned. This was considered the most representative means of taxing a community with single-family, multiple-family, and commercial dwellings — all prominent land uses in the watershed.

Other more recent examples of the stormwater drainage utility are also found in the State of Washington, including King and Clark Counties (Government Finance Research Center, 1980c). In its application to a local government, this concept may require a new way of thinking on the part of the government and its agencies.

The Lake Management District, another innovative concept, originated in Wisconsin where enabling legislation provided for a system of districts with powers to implement and fund management programs. The primary objective of the district is to protect and restore the lake quality. Nationally, the complexity of districts varies from more complex ones in Wisconsin to simpler examples in Pennsylvania and California. To be effective, this approach may require State enabling legislation and a strong local commitment.

Another form of management institution that holds potential for lake watershed management is the homeowners or community association. These bodies often have powers delegated to

them by the State or local governments that allow control of open space and park lands and facilities, as well as certain lakes. They often have full management and operations staffs as well as operating budgets that make them potentially ideal as lake watershed management authorities. With adequate professional assistance, such organizations could adopt standard management functions for both the lake and its watershed. Funding for such organizations is usually provided for by a fixed annual assessment on the value of each resident's property, the immediate beneficiary of lake improvements.

An excellent example of one such organization is the Westlake Lake Management Association Inc. of Westlake Village, Calif. (Hanson, Bigelow, 1977). The Westlake Village Association has fully accepted the management responsibility for its lake and watershed.

Another example of management responsibility being accepted by such an organization is the Columbia Parks and Recreation Association in the new town of Columbia, Md. (Howard County Dept. of Public Works, et al. 1979). The Columbia Association, in accepting responsibility for managing its three major lakes and several small ponds, has hired a resident staff ecologist as watershed manager. With the results of its Section 314 Phase I study (now in progress), The Columbia Association will be able to not only monitor the lakes and tributary streams but also implement a complete management program. This will probably involve property owners in the watershed and a combination of existing agencies with water quality management responsibilities.

Although a watershed management program may not, in itself, be a regulatory activity, tools exist by which local or State governments can better control certain land uses and watershed activities. Many governmental bodies have established ordinances to manage stormwater runoff, erosion and sedimentation, flood plains, and wetlands, among others.

Appendix D

(RESERVED)

Appendix E

PROTOCOL FOR THE CONDUCT OF PHASE 1 DIAGNOSTIC-FEASIBILITY STUDIES AND ENVIRONMENTAL EVALUATIONS

INTRODUCTION

This protocol describes the procedures which are to be used in obtaining and presenting the information required in a Phase 1 Diagnostic-Feasibility Study. It is organized in the same manner as Appendix A to 40 CFR 35 Subpart H, which describes the required Phase 1 outputs. For each subheading from Appendix A, the protocol defines the requirement, lists potential sources of existing information to meet the requirement, identifies methods of developing any additional information needed, and describes the form in which the information is to be presented.

The user should note that, with two exceptions, the requirements in 40 CFR 35 Subpart H Appendix A are minimum requirements which are to be addressed in any Phase 1 study or equivalent diagnostic-feasibility study. Information is to be presented in the order in which it is given, and in the format described in this protocol. Additional material beyond the minimum requirements should be incorporated in consistent format where logically appropriate. The prescribed methods must be followed unless the EPA Project Officer approves alternative procedures.

The limnological data requirements described under (a)(10) and (b)(3) may be modified, and frequently are, to suit the needs of a specific project. EPA Project Officer approval must be obtained for any such modification. Once the limnological data collection program has been determined, however, the applicable portions of this protocol must be followed.

Sources of all information presented must be given in the text or in footnotes to text or tables.

REQUIREMENTS FOR DIAGNOSTIC-FEASIBILITY STUDIES AND ENVIRONMENTAL EVALUATIONS

(a)(1) Lake Identification and Location

Correct identification and location of information is essential for program administration and for storage and retrieval of study results.

Requirements:

- A. Official name of lake
- B. State and county in which located
- C. Name of nearest municipality
- D. Latitude and longitude of lake center
- E. EPA Region
- F. EPA major basin name and code
- G. EPA minor basin name and code
- H. Names of major tributaries
- I. Name of water body which receives lake's discharge
 - Approved State water quality standards for the lake.

Sources and Methods:

Items A through D are available in State Lake Classification Survey, if completed. Otherwise, they are to be obtained from U.S. Geological Survey 7.5-minute or 15-minute quadrangle maps.

Items E through G may be obtained from EPA Project Officer.

Items H and I may be read from USGS quadrangle maps.

Item J may be obtained from the State water pollution control or water resources management agency.

Format:

The required information is to be listed in the following format:

Lake Name:

State:

County:

Nearest Municipality:

Latitude/Longitude: (expressed to nearest second)

EPA Region:

EPA Major Basin Name: Code:

EPA Minor Basin Name: Code:

Major Tributaries:

Receiving Water Body:

Water Quality Standards:

— Designated Uses

— Applicable Criteria

In addition, a locating map must be included which shows the lake and its geographical setting, including State, county, and municipal boundaries, tributaries, and receiving waters.

(a)(2) Geological and Soils Description of Drainage Basin

The lake and its drainage basin must be described in terms of geology, groundwater hydrology, topography, and soils.

Requirements:

- A. Geological Description. Describe drainage basin in terms of predominant rock types — igneous, metamorphic, and consolidated or unconsolidated sedimentary. Identify, locate, and describe geologic formations which are aquifers hydraulically connected to the lake or which may constitute sources of materials important in the lake water chemistry (e.g., limestone, phosphate rock, exposed coal deposits).
- B. Groundwater Hydrology. Describe lake in relation to drainage basin groundwater hydrology. Does the lake recharge aquifers through exfiltration? Does it receive groundwater discharge directly? How significant is groundwater compared to surface water in the lake's water budget?
- C. Topography. The terrain can be described qualitatively, but quantitative information on slopes should be included.
- D. Soils. The major soils in the drainage basin should be identified and described in terms of permeability and erodability. Soil loss to water courses should be estimated.

Sources, Methods, and Format:

Items A and B may be obtainable from USGS and State Geological Survey publications, 208 water quality management plans, regional environmental plans, environmental impact statements for other projects in the area, well records, and completed studies by local and State universities. The information is to be presented in descriptive paragraphs. Maps must be included whenever there are more than one or two formations, recharge areas, or aquifers to be described.

Item C may also be available in completed studies described for A and B. If not, slopes can be estimated from contour maps as percentages (the units of change in elevation per 100 units of horizontal distance) by counting the number of contour intervals within a convenient length on a scale. For example, on a USGS map of scale 1:24,000 (2,000 feet = 1 inch), five 20-foot contour intervals within one-half inch would represent a 10 percent slope:

$$\frac{5 \times 20 \text{ ft}}{0.5 \times 2000 \text{ ft}} = \frac{100}{1,000} = 10\%$$

Each subbasin within the lake drainage area should be described in terms of shape. The results may be presented in a slope map, distinguishing at least three categories corresponding to gentle, moderate, and steep slopes (e.g., ≤ 10 percent, 11-20 percent, > 20 percent; actual percentages vary depending on the topographic characteristics of the region). The percentage of each subbasin in each category must be tabulated.

For Item D, soils maps and descriptions are contained in USDA Soil Conservation Service soils surveys, available from SCS or the county conservation district. Soil losses may have been estimated by the Conservation District or as part of a 208 water quality management plan. If not, estimates can be made using models such as the Universal Soil Loss Equation as part of the analysis of nonpoint sources to be undertaken in (a)(9).

(a)(3) Description of Public Access

The benefits to be realized from a Phase 2 project depend in part on the extent of public access to the lake.

Requirements:

- A. Identification and location of public access points.
- B. Description of access points in terms of responsible agency, type, size, facilities, capacity, seasonal limits on use, hours of operation, purposes of any fees charged.

- C. Routes and distances to access points from major population centers.
- D. Public transportation availability, including schedules, fares, and service areas.

Sources, Methods, and Format:

A map of the lake must be prepared for item A. Information is available from the governmental agencies responsible for operation of the various access points.

Item B information, available from the same sources, must be shown in tabular form, following the example in Table E-1. If any of the access points are located on privately-owned land, the conditions under which public use is permitted should be described.

Item C can be obtained from and shown on a regional highway map, on which the population centers, access points, and routes have been highlighted. Public transportation systems must also be mapped, and the other information under Item D must be included in an accompanying table. (The Item C and D maps may be combined if the result is not confusing.)

(a)(4) Description of Size and Economic Structure of Potential User Population

Information on public access is not meaningful without information on potential lake uses.

Requirements:

- A. Size of resident population using or potentially using the lake
- B. Size of any significant seasonal user population increment within 80 km
- C. Distribution of population — major centers, population densities

- D. Pertinent economic characteristics, including as appropriate:

1. General income levels
2. Major employment sources
3. Chronic unemployment
4. Housing shortages
5. Urban blight
6. Relationship of lake to local economy (water supply, tourism, commercial fishing, sport fishing, real estate values).

Sources and Methods:

Information to meet all requirements is available from U.S. Bureau of the Census; State, regional, county, and city planning or economic development agencies; recreation agencies; bureaus of tourism; and Chambers of Commerce. Frequently there are unpublished but readily available data that provide more detail than found in publications. This is particularly true in the case of the census, where population and economic statistics are reported by county, municipality, and metropolitan statistical area, but are tabulated by much smaller census tracts and blocks. Tract and block information is available on computer tape.

Format:

Statistics may be presented in tabular or graphic form, as appropriate. Population lends itself to tabular presentation, while population distribution is easily shown on a bar graph. Economic information which is not statistical, such as descriptions of housing or of urban problems, may be presented in narrative form.

Table E-1
Sample Description of Public Access Points

Name	Responsible Agency	Type	Land Area (ha)	Lake Frontage (m)	Types and Capacities of Facilities
North Landing	Boro of Lakeville	Boat Launch	0.3	22	Launching ramps (2) with capacity for boats up to 25 ft. long, 3 ft. draft* Parking for 40 vehicles
West Park	Lakeside Township	Town Park	2.1	60	Picnic tables (20) Nature center Jogging trail Volleyball and tennis courts Parking for 150 vehicles
New State Park	State Dept. of Outdoor Recreation	State Park	62.0	250	Campsites (25) Launching ramp with capacity for small outboards 100 m public beach Marshland bird sanctuary Food concession (swimming season only)

*Launching fee of \$2.00 used for seasonal maintenance of launching facilities.

(a)(5) Summary of Historical Lake Uses

Comprehensive baseline information on historical uses and their relationship to water quality problems is indispensable for the projection of potential benefits needed to justify a Phase 2 award, and for assessment of actual results from restoration or protection.

Requirements:

- A. Inventory of present and past lake uses
- B. Statistics on present and historical usage, by type of use
- C. Analysis of relationship between historical trends in lake water quality, uses, and usage.

Sources and Methods:

Possible lake uses include, but are not limited to:

- Recreation — on lake and adjacent public lands, broken down by specific type, e.g., swimming, boating, water skiing, fishing, ice fishing, camping, picnicking, jogging, etc.
- Aesthetic enjoyment — enhancement of activities, other than recreation on the lake, by visual amenity the lake provides
- Flood control
- Fish and wildlife propagation and/or maintenance
- Water supply (potable, industrial, agricultural)
- Power generation
- Commercial navigation
- Research and education
- Commercial fishing.

Lake usage is defined as the magnitude of participation in a given use. For recreational and aesthetic uses, it is measured in user-days. Other usages are measured in units appropriate to the specific use:

- Flood control — flood storage volume in m^3
- Fish and wildlife — area of habitat in hectares, species present, population sizes, etc.
- Agriculture — annual volume of irrigation water, and/or hectares of irrigated land
- Water supply — population served
- Power generation — thousands or millions of kilowatt-hours per year
- Commercial navigation — cargo tonnage (metric tons) or value per year
- Research and education — number of projects, number of students
- Commercial fishing—value of annual catch, weight of annual catch.

General uses of any public lake are usually known by the State environmental, natural resource, water resource, or recreation agency. More detail, such as types of recreation or

types of fishing, may have to be obtained from specialized or local sources, such as county or municipal park and recreation departments, State fish and game commissions, or lake associations.

Any organization operating any type of facility on the lake is a logical source of statistics on the facility's usage. They should be asked to provide estimates if they do not have exact information. Annual usage data are usually sufficient, but the investigator should be alert to seasonal variation which may reflect water quality degradation. For example, total park usage may be nearly the same for two different years, but usage during the swimming season may be much lower in one of them because of an algal bloom. In such a case, it would be important to record swimming season usage as well as total annual usage.

To demonstrate the effects of water quality changes on uses and usage, all available years of usage data should be examined for trends, both in lake use and in specific uses. These are compared to trends in historical water quality, based on data obtained from State water quality agencies, county or local environmental or public health offices, lake associations, etc. Local newspapers may be good sources of the dates of specific events, such as algal blooms, fish kills, and herbicide treatments. Any apparent relationships should be identified, either by inspection, statistical techniques such as regression analysis, or (if adequate data are lacking) qualitative observations.

Format:

Use and usage information is to be reported in tabular form, as illustrated in Table E-2 for a lake with a single access point, also used for water supply. Trends in use and usage related to water quality should be presented in the clearest and most convincing manner. In an ideal situation, graphs such as the one in Figure E-1 can be prepared. However, sufficient data are often not available, and a narrative presentation may have to be used instead.

Whenever trend information is presented, it must be accompanied by a discussion which explains the relationships believed to exist and which identifies any extraneous influences which may be reflected in the data. In Figure E-1, for example, it is apparent that changes in water quality reflected in Secchi disk transparency have led to a decline in swimming and fishing. Total park usage statistics are included in the figure to show that the reduction in swimming and fishing was not the result of an overall decline in the use of the lakeside park, which also provides camping and other recreational opportunities. Camping appears unrelated to the water quality

changes experienced to date; in fact, it increased in recent years, probably because of increased use by nearby residents in response to rising gasoline costs. Public water supply customers increased through 1976, then began to decline slowly. It should be important to discuss general population trends in the area as part of any argument that this decline resulted from taste and odor problems caused by algal blooms.

(a) (6) Population Segments Adversely Affected by Lake Degradation

The Phase I study agency should be alert to differential impacts of lake degradation among population groups and should explain any that are discovered. For example, a deteriorating fishery may affect a group of economically disadvantaged persons who fish to supplement family food supplies, or it may cause boat rentals, and tackle and bait shops to go out of business. As another example, loss of contact recreational uses may deprive local children of their primary summer recreational opportunity, especially in economically depressed areas.

Requirements:

Identification, description, size, and location of any population segment which has been or will be more adversely affected by lake degradation.

Sources and Methods:

Information on this subject may be hard to obtain, but lake association members, park officials, fishery department personnel, planning agencies, police, and others whose work involves observation of activities around the lake may be able to provide opinions if quantitative data do not exist. Housing or redevelopment agencies, welfare officials, and civic associations are also likely information sources.

Format:

This information can be presented in narrative form.

(a) (7) Comparison of Lake Uses to Uses of Other Lakes in Region

In considering a lake for a Phase 2 award, it is necessary to know whether there are other opportunities for the same uses available to the same population.

Requirements:

- Summary of statistics on other publicly-owned lakes within 80 km of lake under study, including: extent of public access, uses available to the public (with capacity of facilities if information is available), and summary of available usage data.
- Discussion of relationship of lake under study to other lakes.

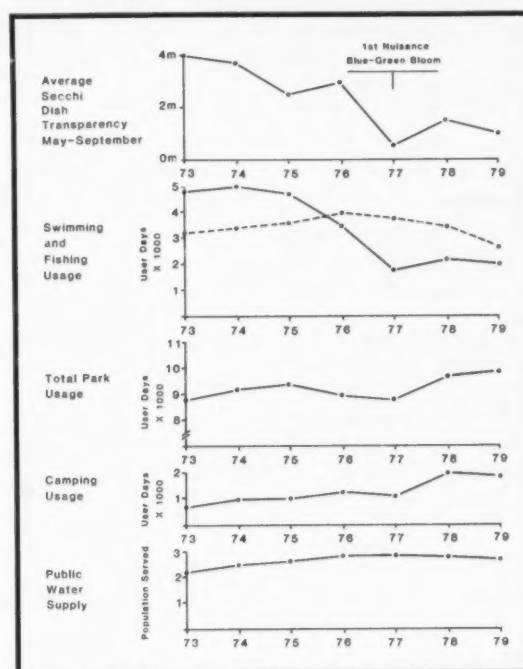


Figure E-1. Historical Trends in Lake Use and Water Quality.

Table E-2
Historical Statistics on Lake Use

Use	Annual Usage ^a						
	1973	1974	1975	1976	1977	1978	1979
Swimming ^b	4,800	5,000	4,700	3,500	1,800	2,200	2,000
Fishing	3,200	3,400	3,000	4,000	3,800	3,500	2,700
Boating	c	c	c	e	c	c	c
Camping	1,100	1,300	1,200	1,250	1,100	1,200	1,400
Nature Study	c	c	c	c	c	c	c
Water Supply ^d	2,200	2,490	2,610	2,800	2,800	2,780	2,700

^a In user-days per year except where specified.

^b May 15-September 15 season.

^c No separate records available.

^d Population served (estimated as 3.5 x number of households).

Sources, Methods, and Format:

Lakes within an 80-km radius can be displayed using an accurate State or regional map, which should be included in the Phase 1 report. The other information required in item A can be shown in a table such as Table E-3.

The investigator is not expected to study each lake but should base the material in the table on existing information. County, State, and regional transportation, park and recreation, and fishery officials are logical sources.

The table should be accompanied by a brief discussion of the lake under study, compared to the other lakes, in terms of present and potential uses, water quality problems, and extent and convenience of public access. If statistics are available on regional supply versus demand for lake-based recreation, they should be included here.

(a) (8) Inventory of Point Source Pollution Discharges

In evaluating the likelihood of success of a restoration project, it is important to know the status of point source discharges to the lake or its tributaries. The characteristics of those discharges, and the time period during which they have existed, may yield information on pollutants present in the lake or in its sediments. Furthermore, because Clean Lakes funds are not used for point source abatement, which is covered under other EPA programs, the decision to award a Phase 2 grant depends in part on whether point source pollution is being adequately managed in the watershed. If it is not, the investment in nonpoint source controls and in-lake restoration measures could provide only short-term benefits, or none at all.

Requirements:

- A. Names and NPDES permit numbers of point sources which affect or may have affected (within past 5 years) the lake. Include major storm and combined sewer outfalls
- B. Name of receiving water body for each
- C. Location of discharge points

D. Discharge characteristics:

- Seasonal or year-round
- Average daily flow
- Discharge constituents and concentration or mass per day

E. Abatement actions or other modifications completed, ongoing, or contemplated, with actual or projected completion dates.**Sources and Methods:**

Sources for this information include the EPA regional office, the State water pollution control agency, and, in the case of publicly owned treatment works, the municipalities or authorities responsible for their operation.

Format:

The point source inventory is to be presented in tabular form, accompanied by a map of the watershed showing discharge points. Table E-4 is an example.

(a) (9) Land Uses and Nonpoint Pollutant Loadings

A map and description of watershed land uses provides information which can be used to estimate nonpoint source pollution loadings and to define the task of watershed management.

Requirements:

- A. Land uses in the watershed. The land use classification should include at least the following:
 - Agriculture — cultivated
 - Agriculture — noncultivated
 - Agriculture — livestock production
 - Residential — low density
 - Residential — high density
 - Commercial
 - Industrial
 - Transportation
 - Forest
 - Other open land
 - Water.
- B. The area of each land use as a percentage of the total drainage area.

Table E-3
Other Publicly-Owned Lake Resources in the Region
(Total number of lakes = 13)

Description of Public Access	Uses Available to Public	Public Usage
County parks (2)	Swimming, fishing, picnicking	52,000 ^a
Public landings (15)	Boat launching	6,000 ^b
Federal Wildlife Sanctuary (1)	Nature study and photography only	120,000 ^b

^aIn user-days per year.

^bIn visitor-days per year.

C. Land use map. This is an optional requirement. It is not necessary when the watershed is almost entirely in a single land use, nor will it be helpful when several land uses are so mixed throughout the watershed that a single list of categories by percentage provides an adequate description. A map should be included when the land use mix varies among subwatersheds, so that the nonpoint source contribution from one subwatershed could be expected to be significantly different from that constructed by another one. It is usually not possible to produce a useful map when the lake watershed is extremely large, as in an on-stream impoundment or the lowermost lake in a chain of lakes. Judgment must be exercised in deciding how much detail to include in such cases. For example, land uses in the direct drainage area and in tributaries flowing directly to the lake might be described in detail, while land uses upstream along the main channels or in the direct drainage areas of lakes higher up in a chain might be summarized.

D. Nonpoint source pollutant loading by land use category. (When a map showing land use by subwatersheds is produced, nonpoint source loadings should also be estimated for each subwatershed.)

Sources and Method:

Sources of land use information include areawide water quality management planning agencies and regional or county planning commissions. Information can also be taken directly from aerial photographs available from Soil Conservation Service, Agricultural Stabilization and Conservation Service, and

county or regional planning agencies. The U.S. Geological Survey's LUDA program, which uses multi-spectral scanner imagery, produces land use maps and tabulations which may be useful for this purpose, depending on the size and complexity of the watershed.

Pollutant loading estimates for the various land use categories may be available from completed 208 planning work at the cognizant areawide water quality management planning agency. If not, values per unit area found in the scientific literature may be used; Section 4.0 and Appendix C to this manual contain some of this material and provide references to other sources of it. Factors used in their sources must be stated in this section.

Specific soil loss estimates for agricultural land, large construction sites, and other land uses characterized by large amounts of open land can be developed using the Universal Soil Loss Equation.

$$A = RLSKP$$

where

- A = soil loss per unit area
- R = rainfall factor
- L = slope length
- S = slope steepness
- K = erodibility factor
- C = cropping and management
- P = conservation practices

Assistance in developing these estimates can be obtained through the county conservation district or directly from USDA Soil Conservation Service. Wischmeier and Smith (1965) and Wischmeier, et al. (1971) are useful references.

Table E-4
Point Source Inventory

Name	NPDES #	Receiving Water	S/C/I ^a	Discharge Flow ^b	Constituents	Conc/Mass	Abatement Actions
West Boro STP	281473321	North Branch	C	200 m ³ /day	BOD ₅ SS N P	18.0 mg/l 40.0 mg/l 3.0 mg/l 5.0 mg/l	Meets current effluent limitations
Acme Battery Co.	None	North Branch	C	10 m ³ /day	Pb SS	3.0 mg/l 200.0 mg/l	Plant closed 6/76
Cooperative Food Processors, Inc.	213256101	Lake	S ^c	500 m ³ /day	BOD ₅ SS	20.0 mg/l 55.0 mg/l	Plan to shift to land application 8/81
Municipal Outlet #3	None	Lake	I ^d	1.2 x 10 ⁶ m ³ /yr	BOD ₅ SS N P	2,500 kg/yr 28,000 kg/yr 800 kg/yr 350 kg/yr	Diversion to South River recommended for Phase 2

^aS = Seasonal; C = Continuous; I = Intermittent

^bAverage daily flow, except where noted.

^c6/30-9/30.

^dMunicipal storm sewer flow and loadings are annual averages.

Lake water quality monitoring results will demonstrate which pollutants are the primary causes of lake degradation. This information can be used in conjunction with the land use data, to decide whether tributary or sub-basin monitoring will be necessary to determine loadings of major nonpoint pollutants more precisely. Watershed monitoring is discussed in detail in Section 10.0 of the *Guidance Manual*.

Format:

All required information, except the optional land use map, is to be included in a single table. Table E-5 is an example. Loadings must be presented in kg/yr.

Table E-5
Watershed Land Use and Nonpoint Source

Land Use	Area (ha)	% Water-shed	Constituent	Loading (kgx10 ³ /yr)
Agriculture:				
Cultivated	370	37	BOD5	4.1
			SS	600.0
			Total N	4.1
			Total P	2.0
Noncultivated	410	41	BOD5	0.4
			SS	120.0
			Total N	0.4
			Total P	0.2
Residential:				
Low density	120	12	BOD5	1.4
			SS	48.0
			Total N	4.8
			Total P	2.0
High density	20	2	BOD5	1.1
			SS	6.7
			Total N	0.3
			Total P	0.1
Forest	170	17	BOD5	0.0
			SS	12.7
			Total N	0.1
			Total P	0.0
Water	10	1	None	None

Methods and information sources used in developing the pollutant loading estimates must be described in a narrative accompanying the map and table. If watershed monitoring and/or modeling is employed to develop site-specific information, methods and results must be presented separately in this section.

(a)(10) Baseline and Current Limnological Data

An investigator must develop a data base to permit selection of appropriate lake restoration and protection alternatives and to provide a

baseline for evaluation of changes in lake water quality resulting from them. This base should include a review of historical data and one year of current limnological data. The data should be sufficient to provide a means of assessing the lake's current trophic status.

Requirements:

- Summary analysis and discussion of historical baseline limnological data.
- Presentation, analysis, and discussion of one year of current baseline limnological data.
- Trophic condition of lake.
- Limiting algal nutrient.
- Hydraulic budget for lake.
- Phosphorus budget (and a nitrogen budget when nitrogen is limiting nutrient) for lake.

Because each lake ecosystem is unique, limnological data needed vary from project to project. However, to maintain minimum standards for diagnostic studies and to facilitate subsequent project and overall program evaluation, a basic set of requirements has been established for all projects. These requirements, and the procedures used to fulfill them, may be supplemented or modified whenever it is appropriate to do so. Approval of such modification by EPA Project Officer is mandatory.

Tables E-6, E-7, and E-8 list the specific types of information to be developed in the baseline lake monitoring program.

Sources:

Potential sources of existing data, and in some cases, continuing monitoring data, include:

- State Lake Classification Surveys
- National Eutrophication Survey
- U.S. Geological Survey
- National Oceanic and Atmospheric Administration
- U.S. Soil Conservation Service
- U.S. Fish and Wildlife Service
- U.S. EPA regional offices and STORET data base
- State agencies with responsibilities corresponding to the Federal agencies listed above
- County health agencies
- Areawide water quality management agencies
- Water and wastewater treatment plant operators
- Research and educational institutions.

Methods:

Surface Area. The surface area is determined by planimetry of the lake surface boundary as

shown on appropriate scale maps or aerial photographs, or by planimetry the contour line of its maximum surface elevation if only contour maps are available. If the lake or pond was surveyed during its construction, surface area data may be available from the agency responsible for the lake or pond's design. If frequent or significant fluctuations in surface elevations occur seasonally, the lake surface area should be determined at maximum and minimum water surface elevations.

Table E-6
Morphometric and Hydraulic Lake
Monitoring Requirements

Measurement	Unit of Measurement
Surface area	ha
Maximum depth	m
Average depth	m
Volume	m ³
Hydraulic residence time	years
Area of watershed	km ²

Table E-7
Physical and Chemical Lake Monitoring Requirements

Quantity	Symbol	Unit of Measurement	Analytical Methods ^a
Temperature	—	degrees Celsius	—
Secchi Disk Transparency	SD	m or cm	—
Dissolved Oxygen	DO	mg/l	360.1, 360.2
pH	pH	—	150.1
Alkalinity (Total)	ALK	mg/l as CaCO ₃	310.1, 310.2
Soluble Reactive Phosphorus ^c	PO ₄ -P	µg/l or mg/l as P	365.1, 365.2, 365.3
Total Phosphorus	TP	µg/l or mg/l as P	365.1, 365.2, 365.3, 365.4
Ammonia — Nitrogen	NH ₃ -N	µg/l or mg/l as N	350.1, 350.2, 350.3
Nitrite — Nitrogen	NO ₂ -N	µg/l or mg/l as N	354.1 ^b
Nitrate — Nitrogen	NO ₃ -N	µg/l or mg/l as N	352.1 ^b
Organic Kjeldahl	N-ORG	µg/l or mg/l as N	351.1, 351.2, 351.3, 351.4

^aReferences listed are from U.S. EPA (1979c).

^bIt is usually adequate to measure nitrate and nitrite in combination. Methods 353.1, 353.2, and 353.3 yield nitrate + nitrite.

^cDefined as dissolved orthophosphate phosphorus.

Table E-8
Biological Measurements Required for Lake Monitoring

Measurement	Test	Unit of Measurement	Analytical Method ^a	Remarks
<i>Primary Requirements:</i>				
Algal Pigment	Chlorophyll <i>a</i>	µg/l	1002 G	Test samples from epilimnion.
Algal Genera Cell Densities	Counting Chamber	no./ml	1002 F	For each major genus.
Algal Cell Volumes	Calculation from densities and average cell volume	mm ³ /l	1002 H.2	For each major genus; optical measurements of individual cell volumes required.
Limiting Nutrient	Algal Assay Bottle Test or Total Nitrogen: Total Phosphorus Ratio	—	802	
Macrophyte Coverage	Observation and Photography	Percent Coverage (each major species)	1004	As a proportion of lake surface area between 0 and 10 meter depth contour or twice Secchi disk depth, whichever is less.
Bacteriological	Fecal Coliforms	no./100 ml	909 C	When used for contact recreation or fishing.
Fish Flesh Analyses	Heavy Metals Synthetic Organic Chemicals	mg/kg mg/kg		When lake is used for fishing.

^aReferences listed are from American Public Health Association (1975).

Maximum Depth. The maximum depth of a pond or lake in meters should be determined from contour maps, or *in situ* by means of a fathometer or sounding line.

Volume. The volume of a lake or pond is determined from measurements made in the field or from contour maps. When no contour map exists, the procedure is to measure depths along cross sections at appropriate intervals throughout the lake or pond. This bottom profile data can be used to prepare a bathymetric map. In a long, narrow lake, the profile data can also be used directly to determine volume by taking the sum of the products of cross-sectional areas and intervals between cross sections. This procedure, depicted in Figure E-2a, should be followed for the entire lake or pond. Note that the area calculations for each subarea noted in Figure E-2a may require use of formulas for area of rectangle, trapezoid, and triangle.* If significant water level fluctuations occur in the project area, the volumes should be calculated based on the extreme water levels expected.

The more common method of determining volume is to measure the surface area of each contour by planimetry, calculate the volume

*Rectangle: length of the base x height; trapezoid: [(sum of the two parallel sides) x height] ÷ 2; triangle: (base x height) ÷ 2.

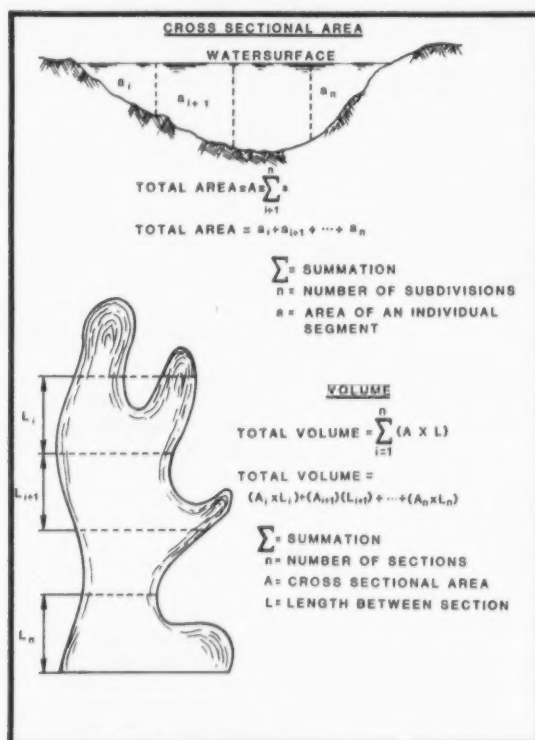


Figure E-2a. Typical Procedures for Volumetric Determination.

between each pair of contour lines, and sum the results, as shown in Figure E-2b.

Average Depth. The average depth in meters is obtained by dividing the water volume by its surface area. The average depth may be affected by extremes in water level fluctuations.

Hydraulic Residence Time. The hydraulic residence time is the theoretical time required to displace the lake or pond volume based on the flow from the water body. It is calculated by dividing the lake volume by the annual water outflow. Consideration should be given to computing hydraulic residence times on a seasonal basis if outflows vary significantly during the year.

The influence of groundwater inflows on the hydraulic residence time may be estimated from the net difference between mean inflows from all surface water sources and rainfall, and mean discharge and evaporation. The U.S. Geological Survey may have inflow/outflow data available from monitoring stations in the tributaries and discharges of larger lakes and reservoirs. Rainfall and evaporation data are available from the climatological data reported by the National Weather Service for the National Oceanic and Atmospheric Administration. Mean annual lake evaporation in the United States can be found in Todd (1970). A

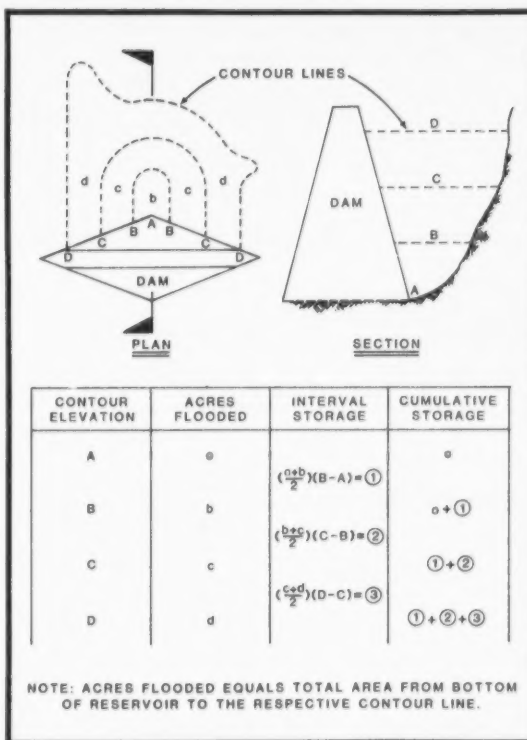


Figure E-2b. Typical Procedures for Volumetric Determination.

computational method for net evaporation loss for a specific reservoir is described by Stall (1964). An introduction to literature and methodology describing groundwater flow measurements can be found in Freeze and Cherry (1979). Stephenson (1971) has extensively investigated groundwater flows in relation to lakes.

Area of Watershed. The watershed area draining to a lake or pond should be determined by planimeter from appropriate scale contour maps or aerial photographs and should be expressed in square kilometers. The divide between the lake's drainage area and adjacent basins should be followed, beginning at the lake outlet, extending to the uppermost reaches of the basin, and returning to the outlet on the other side of the lake area. If a contour map is not available, an estimate of the drainage area may be made by planimetering the area equidistant between two waterways draining in opposite directions.

Chemical and Biological Data Collection. Tables E-6, E-7, and E-8 include citations for the specific procedures to be followed in performing chemical and biological analyses. Literature that contains information on sampling and analytical techniques follow. These references should be examined to provide insight into the requirements of lake investigation, to provide standardized investigative methods and procedures, and to provide quality control of data collected.

Methods for Chemical Analysis of Water and Wastes. U.S. Environmental Protection Agency, EPA 600/4-79-020 (March 1979).

Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents. U.S. Environmental Protection Agency, EPA 600/4-73-001 (July 1973).

Standard Methods for the Examination of Water and Wastewater. Fourteenth Edition (1975) American Public Health Association, American Water Works Association, Water Pollution Control Federation.

Handbook for Sampling and Sample Preservation of Water and Wastewater. U.S. Environmental Protection Agency, EPA 500/4-76-049 (September 1976).

Handbook for Analytical Quality Control in Water and Wastewater Laboratories. U.S. Environmental Protection Agency, EPA 600/4-79-019 (March 1979).

Quantitative Techniques for the Assessment of Lake Quality. U.S. Environmental Protection Agency, EPA 440/5-79-015 (January 1979).

Microbiological Methods for Monitoring the Environment. U.S. Environmental Protec-

tion Agency, EPA 600/8-78-017 (December 1978).

Algal Assay Procedure Bottle Test. National Eutrophication Research Program, U.S. Environmental Protection Agency, Environmental Research Laboratory, 200 S.W. 35th Street, Corvallis, Oregon 97330 (August 1971).

Ecological Evaluation of Proposed Discharge of Dredged or Fill Material into Navigable Waters. Miscellaneous Paper D-76-17, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, Miss. 39180 (May 1976).

Mackenthun, K. M. 1973. Toward a Cleaner Aquatic Environment. U.S. Environmental Protection Agency, U.S. Government Printing Office, Washington, D.C. 20402, GPO Catalogue Number EPA.2:AG2, Stock Number 5501-00573.

Station Selection. Lake sampling station selection depends in large measure on the physical arrangement of the lake and on the type of information to be derived. Station identification is an early step in developing a monitoring program, and it is one of the more important decisions.

The regulations require at least one station "that best represents the limnological properties of the lake, preferably the deepest point in the lake." Other stations may be necessary to fully describe the environmental conditions within a lake. It is imperative that a stream sampling station be located near the mouth of each tributary to the lake in order to obtain loading information and that a station be located near the lake's outfall. The effluent from a natural lake usually will give a good composite of the surface waters of the lake. The discharge from a reservoir penstock located below the thermocline will show water quality in a portion of the hypolimnion during periods of stratification.

Sampling Frequency. The lake monitoring program should include sampling at least monthly from September through April and biweekly from May through August. Sampling times should be arranged to coincide with any seasonal turnovers and to include periods of elevated biological activity, as well as periods when such activity is minimal. Although samples are to be routinely collected during the daylight hours (0800 to 1600) some samples should be collected during the early morning hours to determine if a significant fluctuation in dissolved oxygen concentration occurs.

Vertical Sampling Depths. The regulations specify that samples must be collected between one-half meter below the surface and one-half meter from the bottom, and must be

collected at intervals of every one and one-half meters, or at six equal depth intervals, whichever number of samples is less. These vertical profile samples must be analyzed for all parameters listed in Table E-7.

Water Transparency. Secchi disk measurements in meters must be made at all sampling stations in the lake during each sampling period when the lake is not in-covered. This is a disk, 20 cm in diameter, with four equal sections alternately white and black that was used by Secchi in 1865 in determining the transparency of the water in the Mediterranean Sea. The disk is lowered into the water from the side of a boat opposite that of the sun and the depth at which it disappears from view is noted. It is then raised and the depth noted when it reappears. The mean of the two depths is the limit of visibility.

Limiting Nutrient. As discussed in Section 10.6.2, the ratio of total nitrogen to total phosphorus in the epilimnion can often be used to determine the limiting nutrient. A ratio of 15:1 is regarded as the dividing point; below it, nitrogen is probably limiting, while above it, phosphorus is the likely limiting nutrient. The further the actual ratio is from 15:1, the more reliable the conclusion of the analysis. Thus, if the ratio is 10:1 or less, it is fairly certain that nitrogen is the limiting nutrient. A ratio of 20:1 or greater is a strong indication that phosphorus is limiting (Porcella, et al. 1974). An algal assay bottle test is advisable to determine the limiting nutrient when the ratio is near 15:1. See EPA (1971 and 1978) for test procedure.

Nutrient Budget. An annual nutrient budget for the lake and watershed is determined from water quality and flow data collected at significant inflow and outflow points (including atmospheric contribution and groundwater flow where significant). An annual budget can be constructed by adding together all nitrogen or phosphorus inflows to the lake (in kilograms), and determining the respective amounts removed through lake discharge. The difference is that which remains in the lake, or in some cases, that which may be contributed to the discharge by lake bottom sediments. Kilograms per day in flowing water at any time can be calculated by multiplying the constituent concentration in milligrams per liter by the flow in cubic meters per day and dividing the result by 1,000. Nutrients contained within the lake can be estimated from literature values of the nitrogen and phosphorus concentrations in fish, plankton, and vascular plants, and from analyses of water and benthic sediments, when the respective quantities or masses are known or can be estimated. Obviously, the accuracy of any nutrient budget is enhanced as more data are collected.

Composite Sampling. In collecting data on wet-weather nutrient transport in tributaries, it may be appropriate to employ flow-proportional composite sampling. Some types of automatic sampling equipment can accomplish this mechanically, following operating instructions supplied with the samplers. In cases where compositing must be carried out by hand, the following example may be helpful. Assume a storm event was monitored by collecting discrete 200 ml samples during the storm hydrograph. If the peak flow recorded during the storm was 10 cfs, the proportioning system shown below could be set up and used to volumetrically develop a flow-proportional composite sample.

Typical Compositing System	
Flow (cfs)	Volume of Sample to Add (ml)
10	100
9	90
8	80
7	70
6	60
5	50
4	40
3	30
2	20
1	10

If five 200 ml samples were collected at the flows shown below, a composite sample with a total volume of 363 ml would be created and submitted to a laboratory for analysis, using the proportioning system established.

Example		
Sample No.	Stream Flow (cfs)	Amount of Sample Composited (ml)
1	5.0	50
2	7.5	75
3	9.5	95
4	8.2	82
5	6.1	61
		363

Algae. Samples collected from the epilimnion must be analyzed for chlorophyll *a*. Algal genera should be identified and total numbers and biomass determinations should be made for each genus (Table E-8). Methods for making these determinations are discussed in EPA (1973) and American Public Health Association (1975). Helpful suggestions also may be found in Mackenthun (1973). Transects aid in sampling the plankton population. Because of the number of analyses necessary to appraise the plankton population, however, more strategic points usually are sampled, such as water intakes, a site near a dam in the forebay area or discharge, constrictions within the water body, and major bays that may influence the main basin. Because of significant population variations, plankton samples should be taken vertically at several depths.

Vascular Plants. Vascular aquatic plants need to be surveyed during their active growing period when the population is at a peak. A mapping of aquatic plants growing between the 0 and 10-meter depth contours, or twice the Secchi disk depth (whichever is less) with an indication of predominant species and their relative abundance should be done for future comparisons to record relative changes in the vascular plant population. A mapping of the deep water attached plants such as *Chara* may be accomplished with the use of one of the sampling dredges. Generally, mapping of the vegetation can be accomplished satisfactorily with a boat reconnaissance survey and frequent inspection stops in the littoral area of a standing water basin during the peak of the summer vegetative growing season. Aerial and ground photography, scuba diving, and State fishery agency surveys are useful means of documenting plant coverage and density.

Core Samples and Benthic Sediments. If, in a diagnostic study, dredging is expected to be included in the restoration activities, representative core samples of bottom sediments must be collected. The operation of a Phleger type coring device is described on page 1067 of American Public Health Association (1975). When such a core is obtained, a plunger constructed to fit the diameter of the core sampling tube can be inserted into the bottom end of the tube to extrude the sediments from the top of the tube. In this manner, a precise layer of sediment may be collected for analysis. Although not oriented toward the freshwater environment, helpful information on core sampling is provided in an EPA publication (1978b).

Benthic sediments should be analyzed for total phosphorus, total nitrogen, those heavy metals that may be suspected to be present in above normal concentrations because of pollution, and persistent synthetic organic chemicals if suspected to be present. The determination of percent volatile solids in bottom sediments is a helpful indicator of sediment quality if dredging and disposal of dredged material is a consideration.

In a dredging operation, there is concern about constituents that may be disturbed during the process and liberated into the water column or leached from spoil at the disposal site. To test the potential for such liberation, the sediments are elutriated and the elutriate obtained is analyzed for the appropriate constituents as above. The elutriate sample preparation procedure is described in U.S. Army Corps of Engineers (1976). In performing the elutriate procedure, the following steps are necessary:

1. Sediment samples from the dredging site should be taken with a grab sampler or corer in such a manner to ensure that their characteristics are representative of the proposed dredging site. Approximately 1 gallon of sediment should be collected; if the samples are to be analyzed for trace organics or a large number of constituents, a proportionately larger initial sample should be collected. The samples should be placed in airtight plastic bags or jars (or in glass storage containers if trace organic analyses are to be performed). Care should be taken to ensure that the containers are completely filled with sample and that air bubbles are not trapped in the container.
2. The samples should be stored immediately at 2 to 4° C. They must never be frozen. The storage period should be as short as possible to minimize changes in the characteristics of the sediment. It is recommended that samples be processed within one week of collection.
3. Subsample approximately 1 liter of sediment from the well-mixed original sample. Mix the sediments and unfiltered dredging site water in a volumetric sediment-to-water ratio of 1:4 at room temperature ($22 \pm 20^\circ \text{C}$). This is best done by the method of volumetric displacement. One hundred ml of unfiltered dredging site water is placed into a graduated Erlenmeyer flask. The sediment subsample is then carefully added via a powder funnel to obtain a total volume of 300 ml. (A 200-ml volume of sediment will now be in the flask.) The flask is then filled to the 1,000-ml mark with unfiltered dredging site water, which produces a slurry with a final ratio of one volume sediment to four volumes water. If the volume of water required for analysis exceeds 700 to 800 ml, the initial volumes should be proportionately increased (e.g., mix 400 ml of sediment and 1,600 ml of disposal site water). Alternatively, several 1-liter dredged material/dredging site water slurries may be prepared as outlined above, and the filtrates combined to provide sufficient water for analysis.
4. (a) Cap the flask tightly with a non-contaminating stopper and shake vigorously on an automatic shaker at about 100 excursions per min. for 30 min. A polyfilm-covered rubber stopper is acceptable for minimum contamination.
(b) During the mixing step given in paragraph 4(a), the oxygen demand of the dredged material may cause the dissolved oxygen concentration in the elutriate to be reduced to zero. This change can alter the release of chemical contaminants from dredged material to the disposal site water

and reduce the reproducibility of the elutriate test. If it is known that anoxic conditions (zero dissolved oxygen) will not occur at the disposal site or if reproducibility of the elutriate test is a potential problem, the mixing may be accomplished by using the compressed air mixing procedure instead of the mechanical mixing described in paragraph 4(a). After preparation of the elutriate slurry, an air-diffuser tube is inserted almost to the bottom of the flask. Compressed air should be passed through a de-ionized water trap and then through the diffuser tube and the slurry. The flow rate should be adjusted to agitate the mixture vigorously for 30 min. In addition, the flasks should be stirred manually at 10-min. intervals to ensure complete mixing.

5. After shaking or mixing with air, allow the suspension to settle for 1 hour.
6. After settling, carefully decant the supernatant into appropriate centrifuge bottles. Centrifuge. The time and rpms during centrifuging should be selected to reduce the suspended solids concentration substantially, and therefore shorten the final filtration process. After centrifuging, vacuum or pressure filter approximately 100 ml of sample through a 0.45 micron membrane filter and discard the filtrate. Filter the remainder of the sample to give a clear final solution (the standard elutriate) and store in the dark at 4° C in a clean, noncontaminating container.
7. Analyze as soon as possible for major constituents using accepted procedures.
8. Prepare and test the elutriate in triplicate and report the average concentration of the three replicates as the concentration in the standard elutriate.

Public Health Concerns. If there is a potential concern relating to public health, a diagnostic lake evaluation should include standard bacteriological analyses (American Public Health Association, 1975). Microbiological methods for monitoring the environment have been published by EPA (1978a). Whenever the potential public health hazards include toxic substances, fish flesh should be analyzed for toxic organic and heavy metal contamination. There are no standardized methods per se, but a method for wet digestion of fish tissue for heavy metal analyses has been described by Chernoff (1975).

Quality Assurance. Because of the importance of analyses in determining practical courses of action that may be followed, quality assurance programs to insure the reliability of the water data are essential.

Quality assurance programs have two primary functions in the laboratory. First, the programs

should continually monitor the reliability (accuracy and precision) of the results reported; i.e., they should continually provide answers to the question: "How good (accurate and precise) are the results obtained?" This function is the "determination" of quality. The second function is the "control" of quality. To illustrate the distinction between the two functions, the processing of spiked samples may be a determination of measurement quality, but the use of analytical grade reagents is a control measure.

The analytical methods used should be carefully documented. Any deviation from a cited standard method must be recorded. Documentation of measurement procedures used in arriving at laboratory data should be clear, honest, and adequately referenced; and the procedures should be applied exactly as documented.

Quality assurance procedures have been published in 10 CFR 50, Appendix B and by the Environmental Protection Agency (1979b).

A primary requisite of quality assurance in field sampling is that standard routines are developed and explicitly written. The duty of the quality assurance coordinator is to distribute the procedures to all personnel and to offer training in their application.

A second need is for frequent and proper calibration of sampling and flow metering equipment. The best advice in this regard is to follow manufacturers' recommendations. Calibration should be performed systematically and the results of all calibrations and equipment checks should be permanently recorded. Placing a clearly written calibration procedure with each piece of apparatus is highly recommended.

Control checks should be performed to evaluate the performance and reliability of the sample collection and handling program. The following procedures provide a check on some aspects of sampling:

1. Duplicate samples — Duplicating automatically collected or grab samples on a random basis provides a precision check.
2. Split samples — Subdividing samples for analysis in different laboratories provides an accuracy check.
3. Spiked samples — Adding known amounts of particular constituents to actual samples or blanks is another technique for evaluating accuracy.
4. Sample preservation blanks — Adding preservatives to blanks in normally used concentrations reveals any effects preservatives may be exerting on results. Any contribution by preservatives is then

subtracted from real sample values. As a general rule, preservatives should be replenished at least every two weeks.

A minimum of seven sets each of comparative data for duplicates, split samples, spikes, and preservative blanks should be collected to define accuracy and precision levels for data validation.

All sample containers must be fully and properly labelled to insure proper handling during transportation and laboratory analysis. A sample label should be designed at the start of the project. Labels can be printed on water-resistant, adhesive-backed paper, or on a tie-on tag. Mark with an indelible pen.

Sample labels must contain at least the following information:

1. A unique number for each and every sample
2. Collection date and time
3. Sampling site
4. Sampling depth
5. Type of sample (composite or grab)
6. Name of sampling technician.

Additional items such as the preservative used and the analyses to be performed may also be placed on sample labels. A check-off system is a convenient method of designation for these purposes. Figure E-3 presents an example of a sample label.

Study:		Date:		Time:	
Station:		Discrete		Composite	
☐ TP	☐ pH	☐ BOD	☐ Total Colif.		
☐ PO ₄	☐ Cond	☐ COD	☐ Fecal Colif.		
☐ TKN	☐ Alk	☐ TOC	☐ Fecal Strep.		
☐ NH ₃	☐ Acid	☐ Metals	☐ Other		
☐ NO ₃ /NO ₂	☐ Turb	Technician(s):			
☐ TSS	☐ Color	Remarks/Preservative:			
☐ TDS	☐ Fe				
☐ Chlor a	☐ Mn				

Figure E-3. Typical Sample Identification Label.

Field notes should be recorded in a field notebook at the time samples are collected. For wet weather sampling, waterproof notebook paper should be used. Field records should contain the following information:

1. Unique sample or log number
2. Sample collection date and time
3. Source of sample (name, location, depth, and sample type)
4. Preservative used
5. Analyses required
6. Results of any analyses conducted in the field

7. Weather, flow, or other conditions that may affect results
8. Serial numbers on seals and sample transportation cases
9. The recorder's signature.

Preservatives are often necessary to retard biological or chemical changes or to keep certain constituents in solution until analyses can take place. Preservative techniques include pH control, chemical addition, refrigeration, and freezing. Because changes can only be retarded and not stopped, each analysis must be conducted within a specified time span, depending on the analysis. EPA (1979c) lists recommended preservatives and maximum holding periods for common constituents.

Format:

Basic data for a lake, including physical information, should be presented in concise tabular form. For the physical, chemical, and biological information, organization of the data in some orderly form is the first step in their interpretation.

Data should be combined for individual stations for interpretation. A basic table displays the data for each station arranged chronologically by date of collection in the first column, followed by columns indicating time of collection, flow, and the concentrations of various water quality constituents.

Data for one or more years on a year-round basis, or for some other protracted period, should be separated into segments of similar flow and temperature combinations. Year-round data may be separated by seasons. Data that are obtained daily or several times weekly may be separated by months, or combinations of two or three months with similar stream flow and temperature characteristics. The discharge of a seasonal industrial waste may govern the separation of data. Data for the same month from two, three, or more years may be combined. The important guiding principle is to include sufficient data for statistical reliability within relatively limited ranges of stream, lake, or pond characteristics. In a lake or pond environment it is often advantageous to group the data according to depth strata.

In essence, data organization involves the least complex arrangement and display of the data that will aid in the interpretation of water quality, and facilitate an understanding of the water quality within a lake.

Where historic data are available on the temperature and dissolved oxygen profiles within a lake, for example, comparative calculations for water quality constituents among specific

years can be made of the volume of water within a particular portion of the profile. Through such a method, a judgment can be reached on the degree of eutrophic advancement within the water body.

(a)(11) Biological Resources and Ecological Relationships

Information on lake biological resources and relevant ecological relationships is essential for three purposes:

1. Assessment of the effects of present or potential water quality problems on lake biota
2. Projection of benefits from lake restoration and/or protection
3. Evaluation of any adverse impacts of possible restoration techniques on the lake ecosystem.

Requirements:

- A. Composition of lake fish fauna, in terms of dominant species and estimated populations
- B. Identification and approximate numbers of waterfowl supported by the lake, indicating whether use is seasonal, year-round, or during migration only
- C. Identification of other wildlife in any way dependent on the lake
- D. Discussion of the relationships of the organisms identified in A, B, and C to the rest of the lake ecosystem, in terms of habitat, spawning or breeding grounds, and food chains
- E. Comments on the effects of water quality problems on biological resources, both direct (such as low dissolved oxygen or toxic pollution) and indirect (habitat degradation, loss of food organisms).

Sources and Methods:

Since this type of information is difficult and expensive to obtain through field data collection, investigators should make maximum use of existing information. Likely sources include:

- State Lake Classification Survey
- U.S. Fish and Wildlife Service
- U.S. Heritage Conservation and Resource Service
- State outdoor recreation department
- State environmental and/or natural resource agency
- State fish and game departments
- County park and recreation department
- Lake associations
- Sportmen's associations
- Naturalists' organizations (Audubon Society, etc.)
- Research and education institutions.

Much of the material obtained from these sources will be qualitative or approximate — for example, creel census data on fish rather than actual in-lake population estimates, or lists of bird sightings with opinions as to relative abundance, rather than counts. As much information of this type as possible should be obtained. With the assistance of local experts such as the regional officials of the State fish and game department, it can usually be interpreted to provide an adequate description of biological resources.

If information is totally lacking, simple field observations, such as creel census and bird counts, should be relied on as much as possible. The Clean Lakes Program does not require quantitative fish sampling or extensive surveys of benthic organisms, and it is advisable to avoid them because of time and expense except in projects where the information is essential.

In describing ecological relationships, local experts are again good sources of information. University faculty in biology or fish and wildlife management should be able to assist in determining the habitat and food requirements of the important lake organisms. Two useful references in this regard are Martin, et al. (1951) and Sculthorpe (1967).

Format:

Organisms which are important in the lake's biological resources should be listed with common and scientific names, in groups (fish, waterfowl, mammals, etc. in separate lists). Whatever information on population size is available — relative abundance, number per unit area, annual catch, etc. — should be included in the list. A narrative evaluation of biological resources should accompany the list.

The basis for a discussion of major ecological relationships is to be a table showing the food and habitat requirements of each important organism. Narrative should be supplied to highlight relationships, to comment on how well the ecosystem is fulfilling the needs of the important organism, and to describe ways in which the lake's water quality problems may be affecting its biological resources. (Some of the last item may have been covered under (a)(5) and may be cross-referenced in this section of the report.)

If quantitative sampling of fish or benthic organisms is required, appropriate references cited in (a)(10) above should be consulted.

(b) (1) Pollution Control and Restoration Procedures

The feasibility study portion of a Phase 1 project begins with a discussion of alternatives considered and a justification of the alternative selected.

Requirements:

- A. Alternative techniques considered
- B. Expected water quality improvement, technical feasibility, environmental impacts, and estimated cost of each alternative
- C. For each feasible alternative, a detailed description of activities to be undertaken and a quantitative analysis of pollution control effectiveness and anticipated lake water quality improvement.

Sources and Methods:

Sections 4.0 and 5.0 of this manual include reviews of pollution control and lake restoration techniques and provide references for more detailed information. These materials serve as the basis for compliance with requirements A and B, above.

Alternatives considered to be feasible after the initial evaluation must be examined more intensively. This examination includes a description of activities necessary to implement the alternative, in sequence, including how and where they would be carried out. Examples of engineering specifications, including preliminary engineering drawings showing any construction aspects of the alternative, must be prepared for each. A quantitative assessment of the pollution control effectiveness and anticipated lake water quality improvement must also be submitted for each feasible alternative. Information on effectiveness is presented in Sections 4.0 and 5.0 and Appendix C, as well as in references cited therein. However, additional analysis requiring nutrient loading and trophic state models may be necessary. Section 10.0 provides an introduction to such techniques.

Selection of a preferred alternative requires application of procedures such as those outlined in Appendix F. The selection made must be justified in detail, and the selection process must provide for full public participation as described under (b)(7), below.

Format:

Each alternative considered should be described in a brief paragraph. Information required under item B can be summarized in a table, with accompanying narratives or notes to expand on or highlight table entries, as necessary. Information for item C must be presented in a separate narrative and set of drawings and calculations. Methods and sources of information used in the analysis should be documented meticulously.

Before final selection of a preferred alternative, the results of (b)(1), including necessary public participation [see (b)(7)], must be presented to the EPA Project Officer in an interim report, and no further work may be conducted on the Phase 1 study until Project Officer approval is received.

(b)(2) Benefits Expected From Restoration

It is a policy of the Clean Lakes Program that projects be selected to maximize the net public benefits which can be obtained from the limited funds available. A restoration project demonstrated in the Phase 1 study to be scientifically excellent may not be selected for a Phase 2 award unless the Phase 1 report also contains a well-developed projection of significant public benefits.

Requirements:

- A. Statement of project objectives in terms of benefits
- B. Discussion of relationship between proposed restoration actions and anticipated water quality changes
- C. Discussion of relationship of benefits to water quality changes
- D. Quantitative estimation of benefits

Sources and Methods:

A convincing demonstration of potential public benefits begins by stating the project objective in terms of benefits. Benefits take various forms, but all involve positive changes in lake use where use is defined broadly to include aesthetic enjoyment and lakeside uses, such as nature study, picnicking, and hiking:

- Preservation of existing uses which would otherwise be degraded or eliminated by deteriorating water quality — e.g., sailing which would become impossible because of shoaling in the absence of erosion controls to be developed and implemented in the watershed.
- Improvement in an existing use — e.g., addition of gamefish to a panfish fishery because of elimination of dissolved oxygen depletion, or decrease in water treatment cost following elimination of algal blooms.
- Increases in user-days for an existing use — e.g., more swimming days possible because of beach closings eliminated through abatement of bacterial contamination from stormwater.
- Addition of new uses — e.g., nature study programs for city schools following restoration of degraded fish and wildlife habitat in an urban lake.

Any given project may produce benefits through one or more of these changes in use. The specific benefit goals should be stated by type and quantity (such as user-days, surface area, etc.) Appendix F to this manual contains suggestions and examples for identifying, defining, and quantifying objectives.

The water quality changes expected from the proposed activity should have been documented under (b)(1) above. The next step is to show the relationship between the anticipated water quality changes described under (b)(1)

and the changes in lake uses. The foundation for this discussion should have been established in the response to (a)(5), in which changes in use because of water quality degradation were summarized. Here, the types of arguments to be presented are illustrated by the following:

The proposed watershed management plan for Lake "X" is expected to reduce total phosphorus loadings by 50 percent, which in turn should make it possible to maintain total P concentrations below 0.010 mg/l. Since phosphorus is the limiting nutrient, this should lead to prevention of summer blue-green algae blooms. As a result, more balanced food-chains will be established for fish, and the diurnal dissolved oxygen extremes which have made it impossible to maintain bass populations in the lake will be eliminated. Upon completion of the project, the State fish and game agency will stock the lake with 18,000 fingerlings each year for three years and anticipates being able to maintain reproducing populations which will support up to 10,000 user-days of fishing per season.

Such a statement depends heavily on the water quality discussion in (b)(1) and on knowledge available from literature or from experts on the water quality requirements for particular uses.

The conclusion of a successful benefits demonstration is a quantitative projection of benefits, compared to baseline lake usage. This involves more than simply projecting the changes in use which will be possible after the project is completed. It is necessary to show that there is demand for the new, improved, or protected uses — that they will actually be taken advantage of by a significant number of

people. Historical usage statistics [(a)(5)] and the size of the region's population [(a)(4)] are the basic data for this discussion. Park and recreation officials and regional planning agencies may have models and statistics on recreation demand which can be helpful. The extent to which capacity is fully used at other lakes in the region is one type of useful information they may be able to supply.

Accessibility to the lake [(a)(3)] and availability of alternative sites for the same uses [(a)(7)] are also components of the benefits estimation. The first determines how easily the potential user population will be able to take advantage of the uses afforded by the restored lake. The second is important in deciding whether supplies of those uses are already adequate in the region or not.

Appendix F to this manual, which concerns selection of project alternatives, contains explanations of several methods for estimating and evaluating benefits which can be applied to this benefit demonstration.

Format:

Parts of requirements A, B, and C may be met by cross-referencing Sections (a)(3), (a)(4), (a)(5), (a)(7), and (b)(1) and extracting pertinent information from them. The format for A, B, and C may be primarily narrative, with tables where appropriate (as in showing the relationships between lake uses and water quality, for example). Items D and E, however, should be presented in a table similar to Table E-9, with notes and narrative to explain methodology, identify sources, and highlight findings. (The hypothetical project to which Table E-9 applies is expected to eliminate swimming and beach closings, add trout to the lake fishery, create a wildlife sanctuary and nature study in the process of developing a marsh which will reduce pollutant loadings in stormwater, as well as reduce water treatment costs.)

Table E-9
Projection of Benefits from Lake Restoration Project

Use Category	Benefit Type ^a	Baseline Usage ^b	Projected Usage ^b	Change in Usage ^b	Value of Annual Baseline Usage ^c	Value of Annual Projected Usage ^c	Value of Annual Increment ^c	Value of Benefit ^d
Swimming	3	60,000	70,000	+ 10,000	120,000	140,000	20,000	140,000
Fishing	2	4,000	4,000	0	8,000	12,000	4,000	28,000
Nature Study	4	0	5,000	+ 5,000	0	5,000	5,000	35,000
Water Supply	2	300 ^e	300 ^d	0	- 750,000	- 730,000	20,000	140,000
Total Benefits								\$343,000

^a 1 = existing use protected; 2 = existing use improved; 3 = increase in usage of existing use; 4 = new use

^b in annual user days unless otherwise specified

^c in current dollars

^d net present value over duration of benefits, in current dollars

^e Users $\times 10^3$

(b)(3) Phase 2 Monitoring Program

A Phase 1 report must include a monitoring program to be implemented in connection with any Phase 2 work undertaken. Post-project monitoring information is essential for project and overall program evaluation. As in the case of Phase 1 monitoring, requirements may be modified with EPA Project Officer approval.

Requirements:

- A. Monitoring program based on same parameters as Phase 1 program described in (a)(10) and Section 10.0.
- B. Provision for continued monitoring for at least one year after construction or pollution control practice implementation is completed.

Sources, Methods, and Format:

The difference between the Phase 2 monitoring program and the (a)(10) baseline data collection is in the use to which the data are put, rather than the types and extent of data to be collected. The diagnostic baseline data are to be used to determine the limnological conditions of a lake that needs to be restored. The Phase 2 monitoring program data are to be used to determine the relative response of the lake ecosystem to restorative actions that have been taken. These differences will be reflected in the Phase 2 monitoring program design in several ways.

- The list of chemical and biological parameters will usually be different, emphasizing those which are expected to change and those which may change as a result of the project. For example, if phosphorus loading reduction in the watershed is the sole pollution control objective of a project, the frequency of sampling other parameters such as nitrogen and suspended solids can be reduced. Conversely, if in the course of Phase 1 a new pollutant was identified which was not included in routine monitoring, that parameter should be included in the Phase 2 program.
- Change in station location. Phase 1 work may have identified specific pollutant sources which are to be controlled and should be monitored closely, necessitating new stations. On the other hand, Phase 1 may have shown that in-lake water quality

was less variable from one site to another, allowing the number of stations to be decreased.

- Change in sampling frequency. Sampling frequency may be reduced if the Phase 1 results show little variation within a given season. Sampling frequency may be increased in other cases, to sample numerous storm events, for example, if nonpoint source control is a major component of the Phase 2 project.

The description of the Phase 2 monitoring program must include station locations, with latitude and longitude, sampling frequency, sampling depths, and parameters to be analyzed. It must also set forth the arrangements made for post-completion monitoring, including responsible agencies, reporting arrangements, and funding sources.

(b)(4) Schedule and Budget**Requirements:**

- A. Proposed milestone work schedule
- B. Proposed budget
- C. Proposed payment schedule.

Methods and Format:

The Phase 2 project proposed at the conclusion of the Phase 1 study should be broken down into its component restoration activities, and a schedule and budget prepared for each. For example, a project may consist of watershed management to control erosion and sedimentation, implementation of agricultural best management practices to eliminate pollution from cattle feedlots, and dredging and nutrient inactivation to correct problems caused by those pollutant sources in the past. Every project also includes project management or administration and water quality monitoring, which should also be shown as separate components.

In developing the schedules, it will usually be helpful to both the reviewers of the application and the project manager to further subdivide the major components into logical work elements. Thus, dredging may be divided into engineering and design, construction (of berms, dikes, pump stations, etc.), and dredging oper-

ations. A simple bar chart (Figure E-4) is sufficient for the schedule; the start and finish dates of work elements and any other milestones, such as public meetings or report submissions, should also be listed.

The budget for each restorative activity should be itemized in sufficient detail so that reviewers can identify the costs of each restorative activity and assess the reasonableness of the application for funding assistance. Table E-10 is an example. Note that a different budget breakdown — into categories such as personnel, equipment, supplies, contractual, construction, and indirect costs — is required as a part of the standard application for Federal assistance (see Section 12.0 for an example).

To assist EPA in planning for disbursement and in monitoring projects, a schedule of payments should be developed, by relating the budget to the schedule and estimating the amount of expenditures for each project quarter.

(b)(5) Sources of Matching Funds

The ability of the Phase 2 applicant to obtain the necessary non-Federal funds for the project is a consideration in project review and selection.

Requirements:

Detailed description of how non-Federal funds will be obtained.

Sources, Methods, and Format:

The Phase 1 report should include details on sources of these funds and mechanisms for obtaining them. The extent to which the funds are earmarked for, or committed to the project should be noted. Section 11.0 of this manual contains an extensive listing of possible

matching fund sources. A table showing sources and anticipated amounts is to be prepared for this section.

(b) (6) Relationship to Other Pollution Control Programs

In keeping with Clean Lakes Program strategy (see Section 6.0 of this manual), Phase 2 projects are expected to follow an integrated approach. They are to be coordinated with other activities dealing with water-related concerns. Other programs not necessarily related to water quality management may enhance the benefits to be realized from lake restoration and should be

Table E-10
Sample Proposed Phase 2 Budget

Watershed Management:			
Develop controls	\$	30,000	
Implement controls		10,000	
			\$ 40,000
Agricultural BMP:			
Identify practices		10,000	
Implementation		150,000	
			160,000
Dredging:			
Engineering		10,000	
Construction		10,000	
Operations		80,000	
			100,000
Nutrient Inactivation:			
Pilot testing		5,000	
Design		5,000	
Application		20,000	
			30,000
Monitoring (3 years @ \$5,000)			15,000
Project Management			60,000
Total Estimated Cost			<u>\$405,000</u>

	1981												Start	Finish
	J	F	M	A	M	J	J	A	S	O	N	D		
Watershed Management:														
Develop controls													1/1	4/30
Implement controls													5/1	12/31
Agricultural BMP:														
Identify practices													1/1	2/28
Implement practices													3/1	10/31
Dredging:														
Engineering													1/1	3/31
Construction													4/1	6/30
Operations													7/1	9/30
Nutrient Inactivation:														
Pilot testing													1/1	2/28
Design													3/1	4/30
Application													10/1	11/15
Monitoring:													1/1	12/31
Project Management:													1/1	12/31

Figure E-4. Sample Schedule

used wherever possible. In the course of the Phase 1 study, all such opportunities for coordination should be investigated, and documentation of the results should be included in the report.

Requirements:

Description of project's relationship to other programs.

Sources, Methods, and Format:

Some of the obvious programs with which a lake restoration or protection project should be coordinated are:

- Construction Grants Program (201)—can provide funding for municipal point source abatement in the watershed
- Areawide Water Quality Management Planning (208)—Federally assisted comprehensive studies of water quality problems, often resulting in various nonpoint source management practices and implementation plans
- Soil Conservation Service — provides technical assistance to farmers and municipalities through conservation district, also funds various small flood control projects, soil and water conservation programs, and watershed management
- Agricultural Stabilization and Conservation Service—provides financial assistance to farmers implementing conservation and agriculture pollution control practices
- HUD Community Development Block Grants—may be used for a variety of purposes, including watershed management, stormwater management, and lakefront development projects
- Heritage Conservation and Recreation Service—has programs for parkland acquisition and development which may complement lake restoration
- Various State programs may provide funds for land acquisition, recreational facilities development, pollution control, lake diagnostic studies, floodplain management, flood control, erosion control, etc.

Section 11.0 of this manual contains more extensive information on programs in which a Clean Lakes grantee might be interested.

The output of this section is to be a listing of all programs considered and a chart or table showing those with which the project will be coordinated and the method and nature of that coordination.

(b) (7) Public Participation Summary

Clean Lakes projects are subject to the requirements of 40 CFR 25, "Public Participation in Programs Under the Resource Conservation and Recovery Act, the Safe Drinking Water Act and the Clean Streams Act," which is a good source of

information on conduct of public participation. These regulations state EPA's objectives for public participation:

(1) To assure that the public has the opportunity to understand official programs and proposed actions and that the government fully considers the public's concerns;

(2) To assure that the government does not make any significant decision on any activity covered by this part without consulting interested and affected segments of the public;

(3) To assure that government action is as responsive as possible to public concerns;

(4) To encourage public involvement in implementing environmental laws;

(5) To keep the public informed about significant issues and proposed project or program changes as they arise;

(6) To foster a spirit of openness and mutual trust among EPA, States, substate agencies and the public; and

(7) To use all feasible means to create opportunities for public participation, and to stimulate and support participation.

The regulations also spell out the general responsibilities for public participation which must be met by EPA, State, interstate, and substate agencies.

Requirements:

Compliance with public participation requirements is to be documented in the Phase 1 study report in a summary which also meets the requirements of the "responsiveness summary" required under 40 CFR 25.8 at specific decision points — in this case, lake restoration method selection — which must accompany a Phase 2 application.

Methods and Format:

The regulations which govern the Clean Lakes Program highlight three areas of Phase 1 studies in which public involvement is required (40 CFR 35.1620-4):

(1) In developing, evaluating, and selecting alternatives;

(2) In assessing potential adverse environmental impacts; and

(3) In identifying measures to mitigate any adverse impacts that were identified.

Fact sheets or summaries are to be distributed at least 30 days before selecting a proposed restoration method, and a public meeting is to be held before the selection is made. An advisory group (40 CFR 25.3) is not required but should be formed if public interest warrants. A formal public hearing meeting the requirements of 40 CFR 25.5 is not generally required during a Phase 1 study, unless dredging or some other activity involving significant modi-

fication of the environment is being recommended as the restoration method.

The summary of public participation is to be a narrative describing:

- Matters brought before the public
- Measures used to meet public participation requirements (e.g., meetings, hearings, advisory groups, newsletters, news media, etc.)
- Public response
- Agency's response to significant comments.

(b) (8) Operation and Maintenance Plan

One of the conditions of Phase 2 awards is that the State must "manage and maintain the project so that all pollution control measures . . . will be continued during the project period at the same level of efficiency as when they were implemented" (40 CFR 35.1650-3). In addition, among the application review criteria is an evaluation of the State's operation and maintenance program for continuation of restorative or protective measures after project completion (40 CFR 35.1640-1). Consequently, an effective operation and maintenance (O&M) plan should be developed during the Phase 1 study and thoroughly described in the report.

Requirements:

- A. Operation and maintenance requirements for each component of the project
- B. Proposed duration of the O&M program, with justification
- C. Agencies which will be responsible for O&M
- D. Measures for implementing the plan and ensuring it is followed
- E. Funding sources.

Sources, Methods, and Format:

Depending on the restorative techniques proposed, the O&M plan may be simple or quite complex. For example, if hypolimnetic aeration is the only technique to be applied, the O&M plan need only be concerned with designating an agency to operate and maintain the equipment and with identifying a source of funds to pay O&M costs. At the other extreme, a restoration project depending heavily on watershed management requires an O&M plan which addresses continuing efforts to implement controls through legislation, technical assistance, education, and voluntary cooperation; monitoring and enforcement of management practice implementation; and continuation and funding for all of the above.

Item A is to be presented in tabular form. Items B and D may be narrative. Item C is to be a table listing participating agencies and their responsibilities. Item E is to be a list of funding sources and projected amounts to be obtained for each.

(b) (9) Copies of Permits or Pending Applications

Some lake restoration measures require permits from Federal, State, or local agencies. Most obvious are the U.S. Army Corps of Engineers permits for discharge of dredged material, which are required under Section 404 of the Clean Water Act. Dredging itself requires a Corps permit if it might affect the navigability of navigable waters. In addition, State approval is usually required for channel modification, alterations to dams or inlet or outlet structures, or chemical applications.

Requirements:

During the Phase 1 study, all permit requirements should be identified and, when the restoration alternative has been selected, the permit application process should be initiated.

Format:

Copies of permits, applications, and other pertinent correspondence, and information on the status of all applications, should be included in the Phase 1 report.

ENVIRONMENTAL EVALUATION

An environmental evaluation of the selected restoration or protection alternative(s) must be included as a Phase 1 study output. There are 14 topics which are required to be addressed; other subjects may be relevant to particular projects and should be covered as appropriate. The evaluation should be clear and concise, since it will be used by decision-makers in selecting projects for Phase 2 funding.

(c) (1) Displacement of People

Certain projects, especially those involving dredge spoil disposal or construction of stormwater diversion systems, may displace people from residences or places of business.

Requirements:

Where any individuals will be displaced, information on numbers, location, and socioeconomic characteristics should be supplied. Measures planned for relocating these persons or otherwise mitigating the adverse impact on them should be outlined.

Sources, Methods, and Format:

The extent of displacement, if any, is to be determined by comparing design drawings with property ownership maps. Affected areas are to be shown on a map. The characteristics of the affected population may be obtained from local or county planning agencies. This information should be tabulated and discussed briefly. Proposed mitigative measures should be outlined in narrative form.

(c) (2) Defacement of Residential Areas

Defacement of residences or residential areas may include adverse visual impacts of structures or spoil areas, taking of land for construction or spoil deposition, and increases in ambient noise levels resulting from equipment operation.

Note that a restoration project often has the opposite effect, enhancing the attractiveness of a residential area rather than detracting from it. A positive impact of this sort should also be documented in the environmental evaluation. Only if there is no effect one way or the other should a simple statement of no impact be supplied in response to this question.

Requirements:

The extent of any potential defacement must be described. The description should include the nature of the impact, whether it is long-term or short-term, location and numbers of residences and residents affected, and the degree to which they are affected (which may vary depending on proximity to the cause of the impact). Mitigating measures considered, such as visual screens, buffer zones, noise barriers, and re-landscaping, should be discussed and the selected ones identified. Positive impacts should be documented similarly.

Sources, Methods, and Format:

Aerial photographs, usually obtainable from planning agencies, provide the best base for identifying impacts in this category. Project features can be drawn on a transparent overlay to the photograph, and potentially affected residences identified. The properties thus identified must then be visited. The extent of impact to be estimated is to be on a map, using zones of impact which are based on proximity to the affecting facility and type of impact. For example, the most severe impact zone might be "unobstructed view, 10 db increase in noise level." A zone of impact would be "obstructed view, 5 db increase." Numbers of residences and persons affected are to be tabulated and keyed to the map.

(c) (3) Changes in Land Use Patterns

Very often, creation of or improvement in a scenic or recreational resource, or the removal of an environmental nuisance, will lead to indirect impacts in the form of changes in land use patterns. These may include construction of facilities to provide lodging for transients, sale and development of nearby property for development in response to property value increases or heightened demand for housing, and construction of transportation, utilities, and commercial facilities to meet the needs of the larger numbers of people thus attracted to the area. All of these lead to reduction in amounts of open space.

Requirements:

The nature and extent of land use effects must be projected. In many cases, however, they can be managed to the community's benefit, through planning and zoning, preservation of priority open space through public purchase or easement, or innovative techniques including transfer of development rights. The measures proposed to control these kinds of indirect impacts, the methods of implementing them, and the responsible agencies should be described.

Sources, Methods, and Format:

Local, county, or regional land use plans provide information on projected or desired future land uses in the absence of the project. Aerial photographs for various years are the best sources of historical trends in land use. Land use changes resulting from the project cannot be predicted with complete certainty. However, the types of development likely to occur as a direct or indirect result of the project can be envisioned — new access points, recreational facilities, new housing, new accommodations for tourists and vacationers, widened roads, gasoline stations, campsites, etc. The comparison of projected numbers of new users to existing usage levels is the basis for estimating demand for new facilities.

Where new development will go is a function of available land, existing zoning, and proximity and accessibility to users. Likely areas are to be delineated on a map and the probable types of development identified for each.

In a descriptive paragraph, the ability of the community to manage and guide any projected changes should be assessed, based on interviews with local planning and zoning officials as well as elected municipal officials. Plans or recommendations for utilization of particular land use control techniques should be explained.

(c) (4) Impacts on Prime Agricultural Land

Loss of the use of prime agricultural land is a matter of national concern. It may come about through direct or indirect impacts.

Requirements:

Assessment of the magnitude of any losses of two types of land:

- Prime agriculture land, whether in agricultural use or in open space
- Other agricultural land currently in agricultural use.

Sources, Methods, and Format:

The local conservation district can assist in identifying prime agricultural land, which is defined in terms of soil type and topography. Land in agricultural use has already been de-

terminated as part of the land use inventory (a)(9). If no impact on agricultural land is projected, a simple statement to that effect is sufficient. Otherwise, the area affected (in hectares) and the permanence of the impact should be discussed. If positive impacts are anticipated, such as the use of dredge spoil as a soil conditioner, they should also be described.

(c)(5) Impacts on Parkland, Other Public Land, and Scenic Resources

In most cases, a lake restoration project will have positive impacts on these resources.

Requirements:

Note any impacts that are projected. In those few cases where adverse impacts are unavoidable, as when public land must be used for spoil disposal, a description of the impacts should be provided. The impacts may be mitigated or offset, by the purchase of other land for public use, for instance, and any such measures proposed should be discussed.

Sources, Methods, and Format:

Unless there are significant impacts in the form of changes in area or location (which are to be shown on maps), the information can be presented in narrative form. Local park and recreation officials are good information sources. Reference should be made to the section on changes in land use patterns [(c)(3)], if any of the indirect impacts or mitigating measures covered in that section involve public land or scenic resources.

(c)(6) Impacts on Historic, Architectural, Archaeological, or Cultural Resources

Requirements, Sources, Methods, and Format:

As a matter of routine, the State official responsible for preservation of historical and archaeological sites must be contacted during a Phase 1 study unless no construction or other land-disturbing activity is contemplated. If there is a local or county historical society, it too must be notified of the proposed restoration project. The results of these contacts should be documented. Should the conclusion be that the selected lake restoration or protection measures will affect a site of importance, the site or sites must be shown on a map and possible alternatives and mitigating measures must be considered and described in this section of the Phase 1 report.

(c)(7) Long Range Increases in Energy Demand

Restoration alternatives which involve aeration, pumping, maintenance dredging, harvesting, or chemical treatments on a continuing basis may cause increases in energy demand over a period of time.

Requirements:

Increases in energy usage should be calculated and included in the report. Any energy savings, such as those resulting from a watershed management program which eliminates or reduces the frequency of maintenance dredging, should also be noted.

Sources, Methods, and Format:

Equipment manufacturers and design engineers can provide information on energy consumption by equipment used in lake restoration or pollutant control. Increases or decreases are to be measured in kilowatts and shown in tabular form.

(c)(8) Changes in Ambient Air Quality or Noise Levels

Short-term impacts on ambient air quality or noise levels are those associated with the conduct of the restoration work itself. Long-term impacts may result from operation of compressors, pumps, or other equipment installed during the project, or from changes in the usage of the lake — increased vehicular traffic at the access points, for example, or more intensive power boat use.

Requirements:

Any short- or long-term changes in air quality or noise levels must be discussed in the context of data on pre-project noise and air quality conditions.

Sources, Methods, and Format:

Information on ambient air quality can usually be obtained from State environmental agencies or local or regional air management agencies. Ambient noise levels must be measured in decibels using noise level meters if noise impacts of the project are expected to be significant. Traffic volume must be projected if vehicle traffic is expected to increase substantially as a result of the project, since it forms the basis of projections of traffic-related noise and air quality impacts. EPA models such as HIWAY can be used to predict traffic-related air quality impacts, where this is a significant issue (see Zimmerman and Thompson, 1975). Results are to be shown on a map, with an accompanying discussion of methods, sources, and findings. This information can usually be obtained from the State environmental agency.

(c)(9) Adverse Effects of Chemical Treatment

Requirements, Sources, Methods, and Format:

The selection of in-lake chemical treatment as a restoration alternative should be preceded by a review of the literature on the ecological impacts of the compounds proposed for use. When there is insufficient information in the

literature to determine the likely impact on lake ecology, it is advisable to conduct bioassays (American Public Health Association, 1975), using representative lake organisms, to determine whether the chemical will be toxic to non-target organisms at the concentrations which will exist in the lake after treatment. If no chemicals will be used, that fact should simply be noted.

Results are to be summarized in narrative form with any appropriate tables.

(c)(10) Compliance with Executive Order 11988 on Floodplain Management

Lake restoration may involve activities which take place in, or result in modifications to, a floodplain. When this is proposed, Executive Order 11988 must be complied with. E.O. 11988's purpose is:

... to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains. ...

Before awarding Phase 2 funds for a restoration project, EPA must determine whether the proposed action would occur in a floodplain, as defined on a HUD floodplain map or a more detailed map if available. (In the absence of either, accepted hydrologic techniques should be followed in delineating the floodplain.) If it would, EPA must first consider alternatives "to avoid adverse effects and incompatible development in the floodplain." The agency may approve the proposed action, if it is the only practicable alternative, but must then design the project to "minimize potential harm to or within the floodplain." It must also circulate a notice explaining the reasons for permitting location within the floodplain.

Requirements:

Sufficient information in the Phase 1 report to meet these E.O. 11988 requirements. Consequently, part of the Phase 1 study must include determination of the location of proposed construction or modifications with respect to floodplain boundaries. If no such activities are proposed within the floodplain, that fact should be stated and no further information need be supplied. Otherwise, the State should project the impacts of the action on flooding safety and floodplain ecology. It should also discuss alternatives outside the floodplain and demonstrate why these are not acceptable. Finally, it should outline mitigating measures to minimize potential harm.

Sources and Methods:

The best sources of floodplain boundary locations are the floodplain maps prepared for the National Flood Insurance Program. Some municipalities may have delineated floodplains independently, for other purposes, and their

information is also useful. Standard engineering techniques can be applied in forecasting impacts on flooding (see Chow, 1964).

(c)(11) Dredging and Other Channel, Bed, or Shoreline Modifications

The discharge of dredged or fill material is managed through Section 404 of the Clean Water Act. A permit for the discharge of dredged or fill material into waters of the United States is required from the U.S. Army Corps of Engineers, Department of the Army, (33 CFR 323). Guidelines to be applied in the issuance of permits for the discharge of dredged or fill material into the waters of the United States at specified disposal sites appear in the 40 CFR 230. The water quality considerations associated with the water disposal of dredged material are specifically addressed in the latter document. Wetlands receive special protection. Certain testing procedures are required in most projects to determine the acceptability of dredged material for discharge to water.

Requirements:

When dredging is employed as a part of the lake restoration process, the potential for harm to those parts of the lake ecosystem not being dredged must be minimized. In considering the removal of certain very toxic deposits, for example, a determination must be made that the process of removing will not pose potential for greater environmental harm than leaving such sediments in place.

The selection of a suitable disposal site for the discharge of the dredged material is a determination that must be considered early in the planning process. Several alternative disposal sites should be considered and discussed in the restoration project proposal. The relative environmental impacts, practicability, and costs for each alternative should be discussed in sufficient detail to allow a reader to reach a reasoned conclusion.

Upland disposal is always an alternative, but transportation costs for such disposal may make it unrealistic. Open water disposal may be an alternative, but a Section 404 permit would be required and the Guidelines in 40 CFR 230 must be followed. The same is true for disposal into any wetlands such as swamps, bogs, or marshes.

When disposing of dredged material, adverse environmental impacts to the waters of the United States should be minimized. Best management practices to prevent such impacts are technically feasible and available (EPA, 1979a). Such practices fall into the categories of minimizing the impairment of water flow or circulation through properly locating and orienting masses of dredged material and providing

flow through such materials; controlling excess sediment loads or turbidity increases; and ensuring containment of potential pollutants within the mass of discharged material. When ecologically important habitats must be severely damaged in order for the lake restoration project to be completed, it should be determined that the environmental value of the restored lake will exceed the environmental cost of the damaged habitat. When such is the case, and the restoration project moves forward, the potential for replacement, relocation, or reconstruction of the damaged habitat should be considered and discussed. All of these factors are described in the Best Management Practices Guidelines (EPA, 1979a).

Several U.S. Army Corps of Engineers publications are very helpful in the ecological evaluation of proposed discharges of dredged or fill material (U.S. Army Corps of Engineers, 1976, 1977). These documents provide information on the effects of dredged materials discharge and on the various tests that may be used to predict such effects. These tests include the elutriate test procedure, algal assay procedure, benthic bioassay procedure, total sediment analysis procedure, community structure determination procedure, and assessment of bioaccumulation potential (U.S. Army Corps of Engineers, 1976).

(c)(12) Adverse Effects on Wetlands and Related Resources

Executive Order 11990, signed May 24, 1977, provides for the protection of wetlands. In order to fulfill its intent, each Federal agency must: avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative; minimize the destruction, loss, or degradation of wetlands; and preserve and enhance their natural and beneficial values. The agency may take into account economic, environmental, and other pertinent factors (42 FR 26961, May 24, 1977).

Requirements:

Wherever wetlands are involved in a lake restoration project, as a filtering and treatment system for nonpoint sediments and nutrients that otherwise would reach the lake; as a site for the discharge of dredged material; or as they may be affected by an altered water level, the Environmental Protection Agency must be provided certain specific information. Such information includes a description of potential alternatives to the involvement of wetlands, along with their estimated economic and environmental costs. Alternatives may include other sediment and nutrient treatment measures, such as the construction of a sedimentation basin and vegetation nutrient utilization belt in the drainageway, or an embankment to pre-

vent wetland flooding. The relative environmental damage to any wetland through its use as presented in the project design should be discussed. All wetlands are valuable environmental resources; some may exceed others in relative worth.

Sources, Methods, and Format:

Applicants should describe the wetlands involved, their size, relative environmental value, relationship to the lake being restored, predominant vegetation types, and other unique features that make them valuable, irreplaceable aquatic resources. Any anticipated adverse effects that implementation of the proposed restoration project may have on wetlands should be discussed, however remote the potential. Such adverse effects would include filling, draining, water level fluctuation, or the introduction of pollutants as a result of direct or indirect restoration activities. When adverse effects or wetlands destruction are discernible, describe fully those measures that will be taken to mitigate damages that may occur or to control such damage beyond the minimum necessary to complete the lake restoration project. Consult with State and Federal fish, game, and wildlife agencies about the particulars of the project and request their views in writing. Include such views in the project proposal and discuss the relative merits of any negative comments in the proposal. Discuss the relative significance of any adverse impacts as weighed against the critical habitat needs of the geographical region. Compare the relative area of habitat destruction against the area of similar habitats in the region.

An effort similar to the above should be undertaken in relation to any adverse effects on fish and wildlife that can be anticipated as a result of project completion. Such would include potential effects on spawning areas or activities, availability of the respective food supplies, habitat destruction or improvement for particular species of the fish or other wildlife community as a whole.

The potential project effects, direct or indirect, on any designated endangered species should be discussed. The Endangered Species Act (16 U.S.C. 1531-1543) provides for regulations that protect endangered and threatened species. It is essential that the existence of any such species be ascertained and noted in a project proposal, as well as any potential project effects on such species. Such species are listed through the *Federal Register* process. Additional information on endangered species can be obtained from the Endangered Species Office, U.S. Fish and Wildlife, Washington, D.C. 20240.

(c)(13) Feasible Alternatives to Proposed Project

A lake restoration project involves a consideration of benefits to the community of public users as a result of environmental enhancement, potential degradation of any ecosystem or portion thereof, a balancing of economic costs against environmental and social benefits, and the institution of measures to mitigate environmental damages that may arise through project implementation. The pros and cons of alternatives to the chosen plan of restorative action should be considered and discussed in the project proposal.

There may be alternatives to the entire project or to certain geographic portions of the project. Does the project need to be done, or to be fully completed as planned? Will other nearby lakes not serve the user needs adequately without restoring this particular water body? Which of all potential alternatives would be expected to provide the greatest environmental benefits?

Requirements:

All such feasible alternatives, including no action, should be discussed in the project proposal in terms of their impacts if implemented, their relative value in terms of the greatest

good for the greatest number of people, and their relative economic cost. A statement should be included explaining why a discussed alternative was rejected in the overall plan of action.

Sources, Methods, and Format:

This requirement can be met through narrative based heavily on (b)(2) and the preceding subsections of (c).

(c)(14) Other Necessary Mitigative Measures Requirements:

This section includes any other actions that have not previously been discussed but that are necessary to mitigate adverse environmental impacts resulting from the implementation of the proposed project. An example might be the effects of drawing down a lake on other waters within the drainageway. Will the quality of the water receiving the lake draw-down water be impaired by the proposed action? What actions have been taken or need to be taken to mitigate the potential impairment? What is the assurance that such mitigative measures will prove successful? What is the time frame for their accomplishment? Has the cost for these actions been included in the project cost?

Appendix F

CHOOSING AMONG ALTERNATIVES

Choosing the best of several lake restoration project designs involves three steps:

1. Defining the objectives to be served by the restoration project.
2. Defining one or more technically feasible project designs which would meet the objectives.
3. Evaluating each design alternative in terms of the objectives stated in Step 1 and choosing the one which most effectively meets the objectives at least cost.

Each step is briefly elaborated below. There is a vast literature on the subject of defining objectives, developing alternatives, evaluating these alternatives, and finally choosing the best. This appendix gives only a general introduction and refers the reader to other publications for greater detail. Lake restoration planners are not required to follow the methods suggested in this appendix, or any other particular procedure, as long as the approach used is logically defensible and satisfies the various policies and requirements described in this manual [especially items (b)(1) and (b)(2) in Appendix E].

Objectives

Since it is a policy of the Clean Lakes Program to select projects which provide high net benefits to the public, the objectives of a project should be formulated in terms of such benefits. In the broadest sense, public benefits are anything to which members of the public attach value. Since something may have positive or negative value, there can be both positive and negative public benefits.

Examples of benefits related to Clean Lakes projects might be:

- Upgrading lake fishery from panfish to gamefish (positive benefit)
- Creation of a school nature study program around the lake ecosystem (positive benefit)
- Enhancement of the aesthetics of an urban lake (positive benefit)
- Using a valued open space to dispose of sediment dredged from a lake (negative benefit)
- Increasing taxes to finance a project (negative benefit)
- Increasing tourism by providing attractive recreational facilities (positive or negative benefit depending on individual attitudes).

To quantitatively indicate the future value or benefit of a project, estimates of anticipated changes in the levels of activity are often developed. However, two prominent problems arise in using activity to indicate value. One is that while activity indicates the existence of value, the two are not synonymous. For instance, two individuals may swim at a lake having a relatively crowded beach. One may consider the experience delightful because he enjoys the opportunity to interact with others. The second may prefer swimming in relative isolation and uses the crowded beach only because no other is available. The value is considerably lower for the second person than for the first, even though they may swim an equal amount of the time. The planner needs to recognize that the amount of value created by a project will vary from one type of activity to another and from person to person.

The second problem in inferring value from activity arises from the fact that the correlation between the two is not perfect. Consider an urban lake that serves as an aesthetic focal point for commuters and others who drive along its shores daily. With increased pollution, the lake may become odorous and unattractive, but there is no change in traffic patterns. After restoration, traffic may still be unchanged although individuals find the drive far more pleasing and valuable than before. In this case, the activity of driving is motivated by values other than the aesthetics of the lake, even though the aesthetic values involved are significant.

Alternative Designs

There are usually a number of ways to achieve specific objectives or benefits. Some alternatives may be so obviously inferior that they can be rejected out of hand immediately. Others may be eliminated because their technical feasibility or reliability is questionable. However, usually several alternatives are real contenders for the best way to achieve the objectives. A representative set of these contenders should be defined and analyzed in sufficient detail so that the alternative finally chosen clearly is the best one available. The Phase 1 report (Phase 2 proposal) should document the various alternatives by describing their relative strengths and weaknesses and showing in what ways the one chosen is superior.

Evaluation

Each alternative selected for analysis should be evaluated to develop the following information for a Clean Lakes proposal:

- The relationship between proposed restoration actions and anticipated water quality changes, including technical feasibility and reliability
- The relationship between anticipated water quality changes and estimated benefits
- The cost of obtaining the water quality changes
- A quantitative statement of the estimated benefits.

Procedures for developing information in the first three categories are described in detail in Appendix E. Development of quantitative estimates of benefits is described next.

Benefits are the values derived from various types of activity. Therefore, estimates of the benefits from a lake restoration are found by first estimating changes in activities which will result from the restoration, wherever it is possible to make such estimates. The activities may be of any sort: aesthetics, fishing, water supply, tourism, etc. The restoration may effect activities in any of four ways:

- Preservation of existing activities which

would otherwise be degraded or eliminated by deteriorating water quality.

- Improvement in an existing activity.
- Increases in an existing activity.
- Addition of new activities.

Any given project may produce benefits through one or more of these changes in activity.

The specific benefits anticipated from a lake restoration must be stated by type and quantity. Estimating these changes in activity begins with a review of the statistics on historical activities [Appendix E (a)(5)]. Ideally, this information is in the form of time trends that show increases or decreases over time, as in Table E-2. Trends need to be projected into the future on the basis of the attributes of the lake's surrounding area (water quality, facilities, access, etc.), the size and character of the region's population (income, age, or other demographic variables) [Appendix E (a)(4)], and the availability of substitute sites for the various uses [Appendix E (a)(7)].

Some projections may be available from other agencies. For instance, regional planning agencies, park departments, and fish and game departments often estimate future activity by type. These estimates may need to be updated or modified, but they do provide a beginning point. In some cases, new activities can be anticipated on the basis of definite commitments of other agencies. Perhaps the county parks department will agree to develop or expand a park on the lake if the lake is improved, or the school district may be eager to institute a nature study program if a suitable area is made available. Finally, the lake restoration planner may need to develop his own forecasts of activities. The Water Resources Council (1979, 1980) provides some suggestions for forecasting recreation and environmental quality. The important point is that future activities need to be estimated as thoroughly and precisely as possible within a reasonable cost. There are some changes in a lake which may not be measurable by changes in activity but which are benefits, either positive or negative, nonetheless. An approach to measuring such changes is described under Number 4 of the Multiattribute Utility Analysis in this appendix.

With activity estimates in hand the next step is to estimate the value of the activities. There are two general approaches to estimating value which are quantitative, flexible, and comprehensive and which also rest on a formal theory of value and choice; these are economics and multiattribute utility measurement. The basic ideas in each are the same; each individual has a desired set of values which can be satisfied to varying degrees by different experiences and the values can be numerically described to reflect the individuals' preferences. Both approaches follow the same general steps of problem-solving: defining the problem, and identifying

the decisionmakers, alternatives, and values relevant to the problem. It is in the last step that the two approaches diverge. Economics uses the process of exchange between buyers and sellers to elicit values. Multiattribute utility measurement goes directly to the individuals involved and, in effect, asks them to state their preferences. Each of these approaches has its strengths and weaknesses. A great many of the goods and services we value in the United States are traded in well organized markets. In the process, values are elicited in the form of prices. However, many items which we value highly are not exchanged in the marketplace. Examples relevant to the Clean Lakes Program include wildlife refuges, park facilities, fish and game management, and pollution control. In these cases, society obtains the goods and services either by providing them through public and private nonprofit agencies or by legal or administrative requirements. In some of these cases, values can still be identified through reference to the marketplace. In others, such an approach is hopeless. Multiattribute utility measurement is a means of quantifying values which are either unavailable or too expensive to obtain from the marketplace. It also provides a means for measuring benefits which do not necessarily manifest themselves as changes in activity.

In evaluating the public benefits associated with lake restoration alternatives, either economic or multiattribute utility measurement procedures may be appropriate, and often a combination of both may be best. This could mean using economics for those values readily obtainable through market analysis, such as lakeshore property value. Multiattribute utility measurement could be used for values far removed from a market, such as the value of a nature study program. What is essential is to use whatever technique best captures the values of the people involved as they relate to the alternatives being evaluated, to present the results in a form useful to decisionmakers, and to clearly document the methods used in the Phase 1 report.

Economic Benefit Estimation

Much has been written on applying economics to the evaluation of public projects. The Water Resources Council (1979) has reviewed this literature and made recommendations and requirements for the use of economic analyses by Federal agencies involved in developing water resources. Lake restoration planners are not required to follow WRC guidelines, but they may prove helpful. Broadly speaking, the Council has decided that certain values can validly be expressed in economic terms. Examples of such values are agricultural development, flood control, and recreation. Values which the Water Resources Council (1980) believes cannot be validly expressed in economic terms include those

associated with ecological, aesthetic, and cultural aspects of the natural and human environment. The Water Resources Council neither recommends nor requires any procedures for evaluating such values. Instead, it leaves the procedure up to the decisionmakers involved.

Multiattribute Utility Analysis

A modern review of the formal multiattribute utility theory as well as some applications are provided by Keeney and Raiffa (1976). A shorter description is contained in Seaver, et al. (1979). Another leader in the field is Edwards (1977 and 1979).

Techniques of multiattribute utility analysis vary in rigor and complexity. All follow the same general steps to identify and quantify benefits or values: (1) identify the individuals or groups whose values are relevant; (2) identify the characteristics or attributes of the alternatives which are relevant to the individuals; (3) rank and weight the various attributes on a numeric scale; (4) determine the utility of each alternative design for each attribute; (5) calculate the total utility, or value, of each alternative; and (6) reconcile differences among individuals to arrive at a final value for each alternative.

These six steps are described in more detail in the following descriptions drawn from Edward's work; they relate to the simpler analytical methods. The methods may not be appropriate in some projects, may be adapted for some, and may be perfectly suited for others. Scope and budget will largely dictate how rigorously they can and should be applied. It would be helpful in any application of these procedures to obtain the advice of an experienced individual to avoid various pitfalls which may invalidate the results. Some of those pitfalls are described in the section Additional Considerations.

1. Identify Stakeholders

Within the community, a number of individuals will be interested in the project because they have some value or values which will be affected by it. These individuals are termed stakeholders. Some may be organized into groups, such as chambers of commerce, conservation groups, lake associations, boards of realtors, or into agencies including planning commissions and State and Federal environmental or natural resource departments. All stakeholders should be represented in the evaluation process. Considerable care needs to be exercised so as not to leave out significant interests who might later cry foul.

2. Identify Relevant Attributes

The watershed's features combined with the actions to be taken to improve or protect water quality will affect stakeholders in various ways. Identifying them will lead to a list of characteristics or attributes of the project that are signifi-

cant to the stakeholders. Since it is entirely possible that stakeholders may not immediately see all attributes that are of concern to them, technicians may need to suggest some attributes. However, it is the stakeholders who make the final judgments of what is and is not relevant. Examples of attributes might be aesthetic quality, number of recreational users, value of lakeshore property, tourist income in the community, ecological impact of the disposal of dredge spoils, total project cost, and the local share of project cost.

3. Rank and Weight Attributes

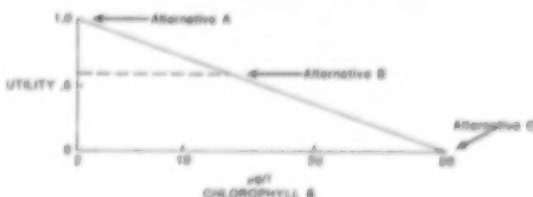
At this stage, each stakeholder ranks the list of attributes in order of importance. Then the stakeholder indicates the importance that each attribute has relative to each of the other attributes. This is done by assigning to the least important attribute a weight of 10 (10 is used rather than 1 to allow later judgments to be finely graded and still be made integers). Then the next least important attribute is assigned a weight which reflects how much more important it is than the prior attribute. If it is twice as important, its number is 20. This procedure is followed through the entire list of attributes. Each subsequent determination must be checked several ways to insure consistency. For example, if Attribute C is weighted 40 because it is twice as important as B, then the stakeholder is also prepared to say that C is four times as important as A, whose number is 10. The set of importance weights thus obtained is added, and each weight is divided by the sum in order to normalize the numbers so that they add up to 1.0.

It is important to remember that the assignment of rank and weights should be carried out in the context of the problem and the alternatives at hand. The stakeholders' perceptions of the severity of the problem and the range of amelioration possible under the alternative actions being considered are key ingredients in this step. Stakeholders are not asked to decide the relative importances of aesthetics and fishing, for instance, in the abstract. Their task, instead, is to determine the emphasis to be given to changes in aesthetic attractiveness and fishing, knowing the current aesthetic condition of the lake, the state of its fishery, and the best and worst results which can be expected given the list of alternatives being considered. Therefore, the performance measures described under Step 4 must be available for use in Step 3 as well.

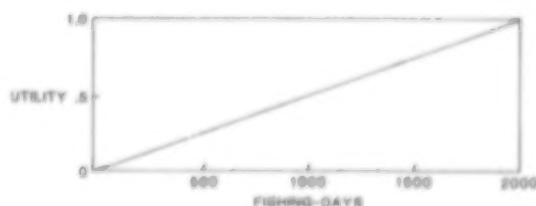
4. Assess Attribute Utility

This step assesses the utility of each alternative design — the extent to which the alternative provides satisfaction in each attribute category. To do this, a "performance measure" for each attribute is determined. For example, if aesthetic character is due to algal concentration, it could

be measured in terms of the amount of chlorophyll *a* which would result from each alternative. Numbers of swimming user-days is another example of a performance measure which might be applied to a set of lake restoration alternatives. The best and worst performance figures for all alternatives with respect to a given attribute can be plotted as 1.0 and 0.0, respectively, on the utility axis of a graph. In the case of the chlorophyll *a* example, the functional relationship of utility and the performance measure might look like the following graph.



The utility of three possible alternatives would be as shown: A would be 1.0, since it resulted in the least amount of chlorophyll *a*; B would be 0.6; and C would be 0.0. If the attribute being considered was fishing, the graph might look like the following, with the best alternative providing the most fishing days.



Two other types of curves are:



Fortunately, in the many cases previously analyzed, it has been found that the precise shape of the curve is not very important as long as there are a number of attributes and stakeholders. In such cases, a linear approximation is acceptable. Using the simplified curves requires identifying only the location of the endpoints (and, in the case of the last two types, the peak) to define the entire curve.

5. Total Utility of Each Alternative

With the utility curves and attribute weights in hand, the value stakeholders place on alternatives can be calculated by using the curve to de-

termine the utilities associated with the various attributes, multiplying the attribute utilities by the attribute weights, and summing the products for each alternative. A somewhat more complicated process termed the multiplicative rule is appropriate in some situations (Keeney, 1974).

6. Reconciling Differences

When only minor differences occur among the values of the various stakeholders, a simple average may be taken with no great disagreement. If such a procedure is considered inappropriate, some process must be used to reduce the differences. This process should actually begin during Steps 2 and 3, when the importance of the attributes to each stakeholder is defined. Ideally, differences can be examined through feedback and a consensus can be reached, or at least the differences can be reduced (Edwards, 1977; Aschenbrenner, 1976; Bauer and Wegener, 1975a). There is no guarantee, however, that a consensus will be reached, nor should there be, since the essence of the procedure is to express individual values. Nevertheless, since a single value is needed for each alternative project design, some form of compromise must be struck.

In practice, the six steps described are often repeated several times, successively refining the information needed to choose the best alternative. In the following example, the steps are identified each time they occur to illustrate the iterative nature of the process.

Example of Multiattribute Utility Analysis

Assume that a lake undergoing Phase 1 study once had well-established bass fishing that deteriorated during a ten-year period of intensive residential development in the watershed. The loss of bass fishing to the community (Step 1) was the reason the State decided to apply for Phase 1 assistance. Results of the diagnostic portion of Phase 1 showed that the causes of this loss had been caused by increased levels of silt and organic material accompanied by higher water temperature. Most of the sediment had entered during housing and road construction, but storm sewers continued to transport silt and organic debris to the lake.

The State defines the goal of the anticipated Phase 2 project as the restoration and maintenance of conditions suitable for bass fishing (Step 2). The responsible regional planning agency refines this goal, based on the supply of, and demand for, recreational fishing, to be the development of a fishery which will sustain 4,000 angler-days annually. Limnologists determine the requirements of these goals to be:

- Clean sand bottom in shallows for bass spawning
- Maximum depth in excess of 4-1.2 meters for at least 1 hectare.

Through the use of bathymetric maps, sediment cores, and simplified models, the following actions are specified:

- Removal of 10,000 m³ of sediment from deeper portions of the lake
- Removal of 0.5 m of silt in shallow portions
- Prevention of additional sediment accumulations.

Possible techniques can now be identified. In this example they might include:

- Hydraulic dredging
- Drawdown and excavation
- Maintenance dredging
- Stormwater diversion
- Stabilization of steep slopes
- Settling basins on tributaries
- Silt traps at storm sewer outfalls
- Erosion controls for new construction
- Street sweeping.

These techniques are combined in various ways to define the alternative plans from which a final selection will be made:

- Alternative A: Complete drawdown and excavation, stormwater diversion, and tributary settling basins.
- Alternative B: Partial drawdown and excavation, stormwater diversion, hydraulic dredging, and tributary settling basins.
- Alternative C: Partial drawdown and excavation, hydraulic dredging, silt traps, street sweeping, slope stabilization, and tributary settling basins.
- Alternative D: Partial drawdown and excavation, hydraulic dredging, stormwater diversion, and erosion controls.
- Alternative E: Do nothing.

The following monetary costs are developed for each of the techniques:

- Complete drawdown and excavation — \$150,000
- Partial drawdown and excavation, plus hydraulic dredging — \$200,000
- Stormwater diversion — \$500,000
- Silt traps, street sweeping, and slope stabilization — \$150,000 capital cost; plus \$30,000 net present value for 10 years operation and maintenance costs — \$180,000
- Tributary settling basins — \$50,000 capital costs plus \$12,000 net present value for 10 years — \$62,000
- Development and implementation of erosion controls — \$10,000 initial cost plus \$25,000 net present value for 10 years — \$35,000
- Restocking lake with bass — \$10,000

Other consequences associated with the various techniques are:

- Complete drawdown and excavation: Severe disruption of aquatic ecosystem, temporary loss of all lake benefits for one season, severe truck traffic and noise in

termine the utilities associated with the various attributes, multiplying the attribute utilities by the attribute weights, and summing the products for each alternative. A somewhat more complicated process termed the multiplicative rule is appropriate in some situations (Keeney, 1974).

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- Prevention of additional sediment accumulations.

Possible techniques can now be identified. In this example they might include:

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- Silt traps at storm sewer outfalls
- Erosion controls for new construction
- Street sweeping.

These techniques are combined in various ways to define the alternative plans from which a final selection will be made:

- Alternative A: Complete drawdown and excavation, stormwater diversion, and tributary settling basins.
- Alternative B: Partial drawdown and excavation, stormwater diversion, hydraulic dredging, and tributary settling basins.
- Alternative C: Partial drawdown and excavation, hydraulic dredging, silt traps, street sweeping, slope stabilization, and tributary settling basins.
- Alternative D: Partial drawdown and excavation, hydraulic dredging, stormwater diversion, and erosion controls.
- Alternative E: Do nothing.

The following monetary costs are developed for each of the techniques:

- Complete drawdown and excavation — \$150,000
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- Development and implementation of erosion controls — \$10,000 initial cost plus \$25,000 net present value for 10 years — \$35,000
- Restocking lake with bass — \$10,000

Other consequences associated with the various techniques are:

- Complete drawdown and excavation: Severe disruption of aquatic ecosystem, temporary loss of all lake benefits for one season, severe truck traffic and noise in

residential area, and taking of 3 hectares for spoil disposal.

- Partial drawdown and excavation plus hydraulic dredging: Disturbance of aquatic ecosystem, temporary loss of all lake benefits for a half season, moderate traffic and noise in residential area due to disturbance in pipeline construction and operation, and taking of 3 hectares for spoil disposal.
- Stormwater diversion: Noise and disruption of traffic during construction, slight disruption of stream ecosystem at outfall point, loss of 30 mature street trees.
- Silt traps, street sweeping, and slope stabilization: Slight noise and parking inconvenience, localized disturbance during construction.
- Tributary settling basins: Localized disturbance of stream biota, slight noise and other construction disturbance.

From the various consequences of each technique, a tentative list of attributes is distilled (Step 2).

The results of the analysis to this point are distributed and public meetings are held. There are two results. An additional attribute is identified: property owners, particularly on the lakeshore, consider the lake in its present state of eutrophication to be an eyesore. The project will improve the aesthetic quality of their lives by greatly reducing algal blooms on the lake (Step 2). The second result is that several stakeholder groups emerge in addition to EPA and the local and State agencies which initiated the Phase 1 study: (a) fishermen, (b) conservationists, (c) lakeshore residents, and (d) general residents (Step 1).

Fishermen generally favor the project. Conservationists are concerned over the various negative environmental impacts, particularly those associated with dredge spoil deposition. Lakeshore residents generally favor the project but are concerned about the costs in terms of property taxes. General residents have the same attitudes as lakeshore residents, but since they do not live on the lake, they will receive less of the aesthetic benefit.

Individuals who are respected in the community and who identify with these various groups agree to participate in the multiattribute utility measurement (Step 1). The four stakeholder groups and their representatives are ratified at another public meeting. The list of attributes is also discussed at the meeting. Some are considered unimportant by some people, but no one suggests any additional attributes. Consequently, the list is accepted as comprehensive (Step 2).

The final list of attributes is shown in Table F-1.

Before the ranking and weighting of these attributes, engineers, limnologists, and other technicians review the alternatives to identify a

performance measure associated with each attribute and the level of that performance measure expected to result in each design alternative (Step 3). The results are as follows, and are summarized in Table F-2:

- Improved bass fishing is measured in angler-days. All four alternatives are designed to provide the same output, 4,000 angler-days annually, so this is the upper limit. The lower limit is the current situation, which is 500 angler-days.
- Improved lake aesthetics will result primarily from lower algal concentrations. There will still be some minor blooms during the summer, but they will be fewer in number and less noticeable. The performance measure chosen is average summer chlorophyll *a* concentration. The upper limit, 30 $\mu\text{g/l}$, assumes no restoration project. The lower limit, 2 $\mu\text{g/l}$, is associated with Alternative B.
- The temporary loss in lake use would mean no boating or fishing of any kind. The loss is measured in months ranging from 12 to zero.
- Traffic congestion and noise during construction is measured in the number of blocks affected. The intensity of the congestion and noise level will vary with the type of activity and thus to some degree with the alternatives. However, the greatest congestion and noise is associated with excavation and hydraulic dredging, which are about equal. Consequently, the only variation recognized is in the residential area affected. The upper limit is determined to be 20 square blocks, the lower limit to be zero with no project.
- The maximum number of street trees lost is 30; the minimum is zero.
- Disruption of the lake and stream ecosystems occurs because the aquatic habitat for various life forms is disturbed. The total number of species of flora and fauna impacted is large. However, the disturbance is temporary and all life forms are expected to return to a normal state soon after the project is completed. Nevertheless, public expression of concern for this impact indicates that even

Table F-1
Hypothetical Restoration Attributes

Improved bass fishery
Improved lake aesthetics
Temporary loss of lake use
Traffic congestion and noise during construction
Loss of street trees
Disruption of lake and stream ecosystems
Spoils disposal area
Cost of project

temporary disruption is undesirable, just as is true for residential traffic and noise. It is finally decided to represent the severity of disruption on a scale from 0 to 10. The disruption associated with Alternatives A through E is 10, 7, 6, 5, and 0, respectively.

- Spoil disposal area. All four project designs involve the same amount of spoil to be disposed of in the same location. The upper limit is therefore three hectares, and the lower limit is zero.

- Cost of the project ranges from \$762,000 for Alternative B to zero for no project.

The performance measures are discussed with each representative stakeholder. All agree that the measures are adequate for linear representations of utility (Step 4). Each stakeholder is then asked to arrange the attributes in order of importance, assigning a value of 10 to the least important and scaling the others accordingly (Step 3). This process is carried out in such a way that the weights assigned to the attributes are consistent. Thus, if Attributes A, B, and C have weights

Table F-2
Performance Measures By Alternative

Attribute	Alternative				
	A	B	C	D	E
Bass fishery (angler-days)	4,000	4,000	4,000	4,000	500
Aesthetics (μg chlorophyll <i>a</i>)	3	2	4	3	30
Loss of lake use (months)	12	6	6	6	0
Traffic and noise (blocks)	20	20	15	15	0
Trees (each)	30	30	0	30	0
Disruption of aquatic system (index)	10	7	6	5	0
Spoil disposal (hectares)	3	3	3	3	0
Cost (\$1,000)	722	762	442	735	0

of 10, 20, and 50, respectively, then B is twice as important as A, C is 2-1/2 times as important as B, and five times as important as A.

As one would expect, the weights vary from stakeholder to stakeholder. After some discussion about the reasons for their differences, the group agrees that a simple average adequately represents the combined attitudes of the group (Step 6).

The results are then normalized so the weights add up to 1.0, as shown in Table F-3. After the utility curves are constructed, the attribute utility for each alternative is derived (Step 4; see Table F-4).

Table F-3
Weights by Alternative

Attribute	Weight
Bass fishery	0.30
Aesthetics	0.20
Loss of lake use	0.05
Traffic and noise	0.10
Trees	0.05
Disruption of aquatic system	0.02
Spoil disposal	0.10
Cost	0.18
	<u>1.00</u>

Table F-4
Performance Measures of Each Converted to Utility

Attribute	Alternative				
	A	B	C	D	E
	Utility				
Bass fishery	1.00	1.00	1.00	1.00	0
Aesthetics	0.96	1.00	0.93	0.96	0
Loss of lake use	0	0.55	0.50	0.50	1.00
Traffic and noise	0	0	0.25	0.25	1.00
Trees	0	0	1.00	0	1.00
Disruption of aquatic system	0	0	0.40	0.50	1.00
Spoil disposal	0	0	0	0	1.00
Cost	0.05	0	0.42	0.04	1.00

The utilities in Table F-4 can also be derived algebraically as follows. The most and least desirable level of each attribute in Table F-2 are assigned utilities of 1.0 and 0, respectively. The intermediate levels of the attributes are assigned utilities through a linear function connecting the most and least desirable levels. For instance, the attribute aesthetics has a most desirable level of 2 μ g chlorophyll *a* and a least desirable level of 30 μ g. These levels are assigned utilities of 1.0 and 0, respectively. The utility of intermediate levels is found by the formula:

$$u = 1.0 - \left(\frac{x-2}{28} \right)$$

where *x* is the chlorophyll *a* level in the alternative under consideration. Thus, Alternative C with 4 μ g chlorophyll *a* has a utility of:

$$u = 1.0 - \left(\frac{4-2}{28} \right) = 0.93$$

The total value of each alternative is then calculated by multiplying each attribute utility in Table F-4 by the appropriate weight and summing up (Step 5; see Table F-5). For instance, the utility of alternative A is found as follows: $U_A = 0.30(1.00) + 0.20(0.96) + 0.18(0.05) = 0.501$.

From Table 5, it can be seen that the alternative with the highest value is C. It can also be seen that Alternative A is not significantly better than doing nothing (Alternative E).

Additional Considerations

The foregoing example is simplified in various ways to convey the essential ideas without undue complications. Several of the more serious simplifications are discussed below.

No account is taken of uncertainty. All the performance measures estimated are subject to errors. Some of these errors may be inconsequential, others may be significant. For instance, it is unlikely that the number of trees removed would differ very much from the estimates. However, the number of angler-days, quantity of chloro-

phyll *a*, and other variables may be subject to great uncertainty. To deal with this uncertainty, probability estimates should need to be developed (Edwards, Guttentag, and Snapper, 1975). This could require considerable additional technical work, but it may be necessary.

The process of arriving at a consensus on group weights was easily obtained in the example. However, this is not always the case; sharp differences may occur that are not easily resolved through discussion. In such cases, the community may have to resort to more elaborate processes.

None of the estimated benefits, other than cost of the project, is measured in economic terms. It is quite likely that, in a real case, benefits such as angler-days or lakeshore residents' aesthetic gains could be quantified in economic terms. For instance, angler-days could be assigned a unit-day value from the Water Resources Council procedures, or a travel cost approach might be used. Lakeshore property value increases might be used to reflect residential aesthetic benefits. If judged to be valid, such procedures can give useful information. However, unless all benefits can be estimated in dollar units, the community must eventually combine those which are measured in dollars with those which are not. The final result may differ significantly from one reached by going directly to utility from performance measures such as number of angler-days.

The example assumed linear relationships between the upper and lower limits of the performance measures. In a real case, this simplification should be tested by observing how a departure from linearity, particularly in those attributes with large weights, would affect the final outcome. If the ranking of the alternatives is sensitive to departures from linearity, one of two procedures should be adopted. Either nonlinear functions should be derived as illustrated in Edwards (1977), or the better alternatives may be

Table F-5
Total Utility of Each Alternative

Attribute	Alternative				
	A	B	C	D	E
	Weighted Utility Values				
Bass fishery	0.300	0.300	0.300	0.300	0
Aesthetics	0.192	0.200	0.186	0.192	0
Loss of lake use	0	0.025	0.025	0.025	0.050
Traffic and noise	0	0	0.025	0.025	0.100
Trees	0	0	0.050	0	0.050
Disruption of aquatic system	0	0.006	0.008	0.020	0.020
Spoil disposal	0	0	0	0	0.100
Cost	0.009	0	0.076	0.072	0.180
Total Utility	0.501	0.531	0.670	0.559	0.500

judged sufficiently close in overall value that it makes little difference which is chosen.

The lake restoration planner needs to be aware of possible value or environmental dependence among attributes. Two attributes are value-dependent if the utility attached to one attribute depends on the performance measure of the other attribute. In the example, none of the attributes was value-dependent. Thus, the utility attached to disruption of residential tranquility through traffic and noise was independent of the amount of disruption to the aquatic ecosystem, and vice versa. This may not be the case. A resident disturbed by disruption of the aquatic ecosystem who then has to deal with the traffic and noise around his home may react very negatively. This reaction may be much larger than the sum of his reactions to each type of disruption considered alone. The effect of value dependence is to increase the error between the true value of an alternative and the calculated value obtained using the additive rule described above. In other words, the calculated value becomes a poorer approximation to the true value as the amount of value dependence in the problem increases. Nevertheless, the approximation may still be reasonably good, particularly if the underlying (true) utility functions are monotonic (Gardiner and Edwards, 1975). The multiplicative

rule accounts for some forms of value dependence (see p. 289 in Keeney and Raiffa, 1976).

Environmental dependence arises when the performance measures of two or more attributes are correlated. Suppose it were possible to achieve any amount of improvement in bass fishing from zero to 10,000 angler-days. Suppose also that to increase the number of angler-days, the disruption of the aquatic ecosystem had to increase correspondingly. The two performance measures would be perfectly correlated: one could not be obtained without the other. The significance of environmental dependence is that it presents opportunities to reduce the number of attributes explicitly recognized. Disruption of the aquatic ecosystem is such a case. Conceivably, each species and habitat could be listed as a separate attribute. To do so would enormously increase the technical work involved in defining performance measures and ranges. It would also greatly increase the work required of each stakeholder in defining weights. Since all the species and habitats are disrupted in more or less the same way, they can be grouped together, as in the example. However, care must be taken to insure that stakeholders understand the details of such groupings sufficiently to correctly identify their weights.

Appendix G

INSTRUCTIONS FOR REPORTING WATER QUALITY MONITORING DATA AND ADMINISTRATIVE INFORMATION

The Grants Information and Control System (GICS) and the Storage Retrieval System (STORET) are the two on-line data management systems currently used by the Clean Lakes Program Office. Basic information on each clean lakes project is stored in these systems. GICS is used for administrative and financial information; STORET is used for scientific and technical information. To expedite the collection of data, grant applicants and grantees are required to submit information on specially designed computer forms. This manual has been developed to assist applicants and grantees in completing these forms.

There are three basic information packages: application information, award information, and quarterly updates. Each package contains two parts: a GICS part and a STORET part. Only the GICS portion is required for classification surveys. When a grant is awarded, the award package will be forwarded to the grantee along with

the quarterly update package. Upon receipt, the award package must be completed and mailed to the project officer. At the close of each quarter, the quarterly updates must be completed and sent to the project officer.

GENERAL INFORMATION

Only one box should be used for each letter. The numbers appearing after each item are computer transaction numbers; they do not indicate the number of spaces or the order of appearance. Do not enter information in the shaded boxes marked blank. Be sure to print all entries as clearly as possible. If the information is not available, an N/A should appear as the entry. Since the data bases are not linked and the terminal operators are different for each system, the same entry may appear in both portions. Refer to the sample forms at the end of the appendix that have been completed for the hypothetical phase 2 project in Section 12.

GICS APPLICATION INFORMATION AND STORET BASELINE INFORMATION**GICS**DO NOT FILL IN ANY INFORMATION IN THE BOX MARKED
FOR EPA USE ONLY

Project name 20 Enter the name of the project.
 Project type 87 Enter C for classification (Note: for classification surveys, only items 20, 87, 19, 12, 51, 14, 13, 52 and 11 must be completed), 1 for Phase 1 diagnostic/feasibility studies, or 2 for Phase 2 implementation.
 Total cost 28 Enter the total projected cost of the project: EPA funds plus State and local contributions.
 EPA funds requested 19 Enter the amount requested from EPA.
 Lake name G1 Enter the name of the lake which is being restored or studied.
 Nearest city 39 Enter the name of the city that is closest to the lake.
 County 15 Enter the county in which the lake is located.
 Survey list ranking 59 Enter the number of the lake from the priority list for lake restoration developed during the classification survey.
 Survey year 57 Enter the year the priority was assigned.
 Applicant Name 12 Enter the name of the applicant.
 Address 51 Enter the applicant's address.
 City 14 Enter the applicant's city.
 State 13 Enter a two letter abbreviation for the applicant's State. Contact the regional Clean Lakes Coordinator for the approved State abbreviation.
 Zip 52 Enter the applicant's zip code.
 Representative 11 Enter the name of the individual who is responsible for the application.
 Areawide planning agency 36 Enter the name of the 208 planning agency that is responsible for the watershed and the lake.
 Problem Description 41, 4x Describe as briefly and accurately as possible water quality problems and the resulting impairment of lake use.
 Objective 42, 4Y Describe as briefly and accurately as possible the benefits that will be restored and the method that will be used to restore them.
 Restorative activities, code, cost Briefly describe each proposed restorative activity that will be used on the lake or watershed, enter the code for the activity (Table G-1), and the projected cost of the activity.

Table G-1
Activity Codes

In-Lake Activities	Watershed Activities
01-Dredging	15-Urban BMP's
02-Drawdown	16-Agricultural BMP's
03-Hypolimnetic Drawoff	17-Sediment Control Structures
04-Hypolimnetic Aeration	18-Streambank
05-Whole-Lake Aeration	19-Chemical Treatment of Inflows
06-De-stratification	20-Stormwater
07-Biological Manipulation	21-Biofiltration
08-Lake-Level Control	22-Oil Traps
09-Chemical Nutrient Inactivation	23-Public Education
10-Dilution	24-Other
11-Bottom Sealing	
12-Chemical Plant Removal	
13-Mechanical Plant Removal	
14-Other	

Please sign the form legibly and enter your phone number. You may be contacted if there are errors or unrecognizable entries.

STORET

DO NOT FILL IN ANY INFORMATION IN THE
BOX MARKED FOR EPA USE ONLY

The storet baseline information forms can be used to enter data from a single station or several stations and data that has been averaged for several stations or one station over a period of time.

Storet Page 1 Station Description

The information on this form should be completed only if you have never entered baseline information for this station before. If the station, or stations, are part of a diagnostic/feasibility study, the station description, lake morphometry, and watershed information should be completed only once. All water quality data is entered on the "P" and "D" cards.

The following descriptive information is required for both baseline and monitoring stations:

A Card

- 7-8 EPA REGION — Enter the number of the EPA Region where the lake is located (e.g. "01" for Region I, "10" for Region X).
- 17-19 Unlocking Key — In cases where data must be kept confidential, a three digit code has been provided to the regional EPA offices to safeguard against unauthorized storage and retrieval of water quality data. The STORET coordinator will provide the code for these columns. If data is not confidential, leave these columns blank.
- 25-61 Individual Storing Data — The name, location, and telephone number of the person storing station location information should be entered here.
- 74-77 Lock After Date — This is a sampling date after which data cannot be retrieved unless the Unlocking Key is given. Columns 74 and 75 specify the year, and columns 76 and 77 specify the month after which data cannot be retrieved. For example, a code of 6801 indicates that data stored after January of 1968 cannot be retrieved unless the Unlocking Key is given. If data is not to be locked, code these columns with: 9999. In virtually all cases, this field should have the "9999" code.

T card

- 1-79 The following entries are used to describe the station type. For example, if the sampling station is in a lake, AMBNT/LAKE is coded into columns 1-10 on the T Card.

AMBNT/LAKE for lake stations
AMBNT/RESERV for reservoir stations

AMBNT/STREAM for river or stream stations

AMBNT/SPRING for spring stations

AMBNT/WELL for well stations
AMBNT/CANAL for canal or drain stations

AMBNT/LND for soil samples or crop samples subjected to toxic materials

PIPE/SEWER/MUN/OUTFL for effluent samples from storm-water sewers or combined sewers

PIPE/NTRTMT/MUN/OUTFL for samples from untreated municipal waste discharges

PIPE/TREATD/MUN/OUTFL for effluent samples from a municipal wastewater treatment plant

PIPE/NTRTMT/IND/OUTFL for samples from untreated industrial discharges

PIPE/TREATD/IND/OUTFL for effluent samples from an industrial effluent subjected to treatment

PIPE/PTRTMT/IND/OUTFL for pretreated industrial effluents discharging into a municipal sewer

PIPE/NTRTMT/AGRI/OUTFL for samples from agricultural activities, silvicultural activities, or feedlots

PIPE/TREATD/AGRI/OUTFL for effluent samples from agricultural activities, silvicultural activities, or feedlots subject to treatment

S Card

- 4-5 Lake abbreviation (LAKE ABB). Enter a two letter abbreviation for the lake. If this abbreviation is not unique, a different abbreviation will be assigned by the STORET coordinator; you will be informed of the new abbreviation promptly.
- 9-10 Station number (STA No.). The station number pertains to the sampling locations for the chemical parameters only.
- a) Sampling network: Each station must be described individually. A unique number must be assigned to each station in the network.
 - b) Single sample: Enter 01 for a single station.
 - c) Several grab samples: If the baseline data was collected at several unidentified locations and averaged, enter AV for the station number.
 - d) Single grab sample: If a single grab sample from an unidentified location exists, enter 00 for the station number.

68-69 Lake location State (ST.). Contact the regional Clean Lakes Coordinator for the State code number.

70-72 Lake location county (COUNTY). Contact the regional Clean Lakes Coordinator for the county code number.

Header Card 0

7-12 Latitude (LATITUDE)—Enter the latitude of the station to the nearest second. If the baseline data was collected at one or several unidentified locations and averaged, enter the latitude of the center of the lake.

14-20 Longitude (LONGITUDE)—Enter the longitude of the station to the nearest second. If the baseline data was collected at one or several unidentified locations and averaged, enter the longitude of the center of the lake.

Header Card 3

- 4-27 Station location major basin name. The name of the major basin can be obtained by contacting the regional Clean Lakes Coordinator.
- 28-67 Station location minor basin name. The name of the minor basin can be obtained by contacting the regional Clean Lakes Coordinator.

68-69 Major basin location code (MAJ.) Contact the regional Clean Lakes Coordinator for the major basin code.

70-71 Minor basin location code (MIN.). Contact the regional Clean Lakes Coordinator for the minor basin code.

72-73 Sub basin location code (SUB.). Enter the sub-basin location code if available from the regional Clean Lakes Coordinator.

Header Card 4

4-45 Lake name. Enter the full name of the lake.

Storet Page 2

Header Card 5 (Header card 5 consists of 15 separate lines of information. The line numbers are alpha-numeric and are entered in column 79. These line numbers consist of the numeral 0 through 9 and the letters J through N. Column 80 is always coded with the numeral 5.)

line 05

16-25 Surface Area (SRF AREA). Enter the surface area of the lake. Specify the unit of measurement. Hectares (ha) are preferred.

38-53 Mean depth (MEAN DEPTH). Enter the average depth of the lake. Specify the unit of measurement. Meters (m) are preferred.

65-78 Maximum depth (MAX DEPTH). Enter the maximum depth of the lake. Specify the unit of measurement. Meters (m) are preferred.

line 15

17-25 Volume of lake (VOL OF LK). Enter the volume of the lake. Specify the unit of measurement. Million cubic meters (mcm) are preferred.

43-53 Volume of hypolimnion in summer (VOL OF HYPO SUM). Enter the volume of the hypolimnion during the summer. Specify the unit of measurement. Million cubic meters (mcm) are preferred. If the lake is unstratified enter UNSTRAT.

64-78 Residence time (RES TIME). Enter the residence time for the lake. Specify the unit of measurement.

line 25

20-53 Limiting nutrient and method (LIM NUT/METH). Enter the standard chemical abbreviation for the limiting nutrient and the method that was used to determine which nutrient was limiting.

72-78 Percent of lake covered by macrophytes (PCT LK COV MACRO). Enter the percent of the total surface area of the lake that is covered by macrophytes. Generally this information can be obtained by determining the depth of macrophyte growth and calculating the surface area within this depth. This surface area is then divided by the total surface area and multiplied by 100.

line 35

24-78 Trophic classification and method (TROPH CLASS/METH). Enter the trophic classification (eutrophic, mesotrophic, oligotrophic) of the lake and the method used to determine the classification.

(No entries are required on line 4; lines 5-J have been used to form a table of point source information)

line 55-J5

7-19 Point sources (POINT SOURCES). Enter the names of the major point sources discharging to the lake and its tributaries. Major storm sewer and combined sewer outfalls should be included.

21-29 NPDES number (NPDES NO.). Enter the NPDES number (National Pollution Discharge Elimination System) for each point source listed in the column marked point sources. If no number has been assigned enter NONE.

31-39 Receiving water (REC WATER). Enter the name of the receiving water for each point source discharge.

41-42 River mile (RM). Enter the distance in miles from the mouth of the tributary to the point source discharge.

44-48 Flow in cubic feet per second (Q CFS). Enter the flow of the point source discharge in cubic feet per second.

50-57 Frequency of flow (FREQ FLO). Enter the frequency of flow of the point source discharge if it is intermittent. For example, if a discharge occurs twice a day for 4 hours or once a day for 8 hours, the entries would be 2XD/4H and 1XD/8H respectively.

59-66 Standard Industrial Classification Code (SIC CODE). Enter the SIC code for the point source. The SIC code can be obtained from "The Standard Industrial Classification Manual" published by the Office of Management and Budget. Most libraries will have a copy of this manual. The regional Clean Lakes Coordinator may also be contacted for this information.

68-78 Corrective actions and date (COR ACT/DTE). List any corrective actions for the point source discharge and the date. For example, if a sewage treatment plant will be upgraded by the construction of tertiary treatment in 1987 enter TERT 87.

line L5-N5 (lines L-N have been used to form a table of nonpoint source information; line K5 will be completed later)

7-10 Nonpoint source discharges (NPS). Use the following codes to enter the major types of nonpoint source discharges to the lake and its tributaries:

AGR for agricultural

DEV for urban, residential, major highways, airports, and railroads

FOR for forests

OPN for other open land, e.g. parks, wetlands, and undeveloped land

MIN for mining, e.g. strip mines, quarries, etc.

11-18 Percent area (PCT/AREA). Enter the percent of the total watershed that is covered by the types of nonpoint sources listed in column 7-10.

20-28 Receiving water (REC WATER). Enter the name of the receiving water for each nonpoint source discharge listed in column 7-10.

line K5

40-46 Watershed area (WS AREA). Enter the watershed area. Specify the unit of measurement. Hectares (ha) or square kilometers (skm) are preferred.

56-62 External phosphorus loading (EX P LOAD). Enter the phosphorus loading to the lake in kilograms per day (kg/d).

72-78 External nitrogen loading (EX N LD). Enter the nitrogen loading to the lake in kilograms per day (kg/d).

line L5-M5

- 43-78 Major inflows and outflows (MAJ IN/OUT). Enter the names of all tributaries flowing into the lake followed by a slash (/) and all major outflows from the lake.

line N5

- 43-78 Soil types (SOIL TYPES). Enter the three digit codes for the major soil types in the watershed. The codes are standard soil conservation service codes and can be obtained from the SCS regional office or the county soil survey.

Please sign the form legibly and enter your phone number. You may be contacted if there are errors or unrecognizable entries.

Storet Page 3

Page 3 consists of P and D card information. The P card is used to identify specific water quality parameters which were sampled for at the stations under consideration. Water quality parameters are identified by a five digit numeric code (e.g. pH has the code: 00400), which will be supplied by the project officer. Up to 14 parameters can be coded on the first P card. If more than 14 parameters need to be coded, one continuation card may be used for 16 additional parameter codes.

Parameter card (P card). The parameters and the parameter codes will be specified by the project officer. If there is more than one line of parameter codes a C must appear in space 80 of the first line. The remaining parameter codes can then be entered on the following line.

- 1-4 'P'. This must be coded in the first four columns of the first P card. This is not coded on the continuation card.
- 5-6 Depth code (DPTH CODE). The depth code pertains to the sample depth for each parameter. If the sample is from the bottom, enter B in space 5 and a D in space 6. If the sample was obtained at some other depth, leave space 5 blank and enter a D in space 6. The actual depth will be entered on the D card. If the depth is unknown or the sample is from a stream, leave space 5 and 6 blank.
- 7-76 The five digit parameter codes are entered in this field.
- 77-79 Blank
- 80 Code the letter "C" if there is to be a continuation card. Otherwise, leave blank.

Data Card (D card). This card is used to enter the values for the parameters specified on the preceding P card. The data values follow the order of the parameters on the P card.

Parameter values on the D card *must be separated by commas*. Also, the *last character* on a D, or the continuation of a D card *must be a comma*. If more than one D card is needed, the additional values can be entered on a succeeding card, *starting in the first column*. Parameter values *cannot* be split between D cards.

In the case where a parameter value is missing, a comma is coded on the D card at the position of the missing value.

- 6-7 Lake or stream abbreviation (LAKE OR STR'M ABB). Enter the abbreviation for the lake or stream stated in space 4-5 of the S card.
- 8-10 Enter baseline or monitoring (ENTER BSE or MON). Enter BSE.
- 11-12 Station number (STA NO.). Enter the station number stated in space 9-10 of the S card.
- 15-20 The date that the sample was taken, giving the year, month, and day of collection.
- 21-80 The values of the parameters sampled for are entered in this space. If the letter "D" was coded in column 6 of the P card, the depth at which the sample was taken is entered starting in column 21.

Please sign the form legibly and enter your phone number. You may be contacted if there are errors or unrecognizable entries.

The cards which are required for entering parametric data are the A card, followed by the P card, followed by the D card(s). When submitting monitoring reports, the A card needs to be included only once with each group of reports. On the other hand, it is likely that it will be necessary to have more than one P card. In this case, a new P card *must be created* whenever (a) the order of the parameter codes is changed or (b) there are a greater or fewer number of parameter codes than on a preceding P card. Also, a new D card will have to be made whenever (a) the station, (b) the date, or (c) the depth is changed. As an example, assume that a lake with five stations is sampled on two different dates. Each station has two samples collected whenever it is sampled; one at the surface and one at the bottom. Also, all five stations sample the same parameters. In this case, only one P card is required. However, 20 D cards are necessary (5 stations per collection date x 2 samples per station x 2 collection dates = 20 samples or D cards). If different parameters had been sampled for on different dates, then additional P cards would be required.

GICS AWARD INFORMATION**DO NOT FILL IN ANY INFORMATION
IN THE BOX MARKED FOR EPA USE ONLY**

Project name 20	Enter the name of the project.
Applicant name 12	Enter the name of the applicant.
Address 51	Enter the applicant's address.
City 14	Enter the applicant's city.
State 13	Enter a two letter abbreviation for the applicant's State. Contact the regional Clean Lakes Coordinator for the approved State abbreviation.
Zip 52	Enter the applicant's zip code.
Representative 11	Enter the name of the individual who is responsible for the application.
Restorative activities, code, cost, projected start and completion	Enter the restorative activities that will be used on the lake or watershed, the code (Table 1, page 3) for the activity, the projected cost, the projected starting date (year, month) and the projected date of completion (year, month). Enter CHANGE in the space (Q1-Q10) for any restorative activity that was described on the application but will not be used.

Please sign the form legibly and enter your phone number. You may be contacted if there are errors or unrecognizable entries.

GICS QUARTERLY UPDATE AND STORET MONITORING DESCRIPTION

The quarterly updates must be submitted at the close of each quarter.

GICS**DO NOT FILL IN ANY INFORMATION IN THE BOX
MARKED FOR EPA USE ONLY**

Project name 20	Enter the name of the project.
Applicant name 12	Enter the name of the applicant.
Address 51	Enter the applicant's address.
City 14	Enter the applicant's city.
State 13	Enter a two letter abbreviation for the applicant's State. Contact the regional Clean Lakes Coordinator for the approved State abbreviation.
Zip 52	Enter the applicant's zip code.
Representative 11	Enter the name of the individual who is responsible for the application.
Cumulative payments requested to date:	
Non EPA	Enter the total amount of money requested from all non-EPA sources to date.
EPA	Enter the total amount of money requested from EPA to date.
Restorative activities, code, cost, actual start, actual completion	Enter the restorative activities that are being used on the lake or watershed, the code (Table 1, page 3) for the activity, the actual cost, the actual starting date for activities underway or completed, and the actual completion date for activities that have been completed. Enter CHANGE in the space (Q1-Q10) for any restorative activity that was described on the application but will not be used.
Recreational benefits accrued 43, 42	Briefly describe any recreational benefits accrued to date. List only those benefits that have been realized as a result of the restorative activities.
Date	Enter the date the forms are completed.

Please sign the form legibly and enter your phone number. You may be contacted if there are errors or unrecognizable entries.

STORET

DO NOT FILL IN ANY INFORMATION IN THE
BOX MARKED FOR EPA USE ONLY

Station description information for monitoring stations is essentially the same as for the baseline stations discussed above. One difference is that the 5 cards, which contain morphometric and watershed information, do not have to be filled out. Also, if the monitoring stations are to be the same as the baseline stations (which is highly desirable) it is only required to change "BSE" to "MON" on the S Card. Consequently, for a monitoring station, the only cards required are the A, T, S, O, 3 and 4 cards.

Entering water quality data on the P and D cards is identical to the procedure discussed previously.

SAMPLE FORMS

The forms on the following pages have been

completed for the hypothetical Phase 2 project that was described in Section 12. The EPA USE ONLY section of some of the forms will be completed by the Clean Lakes Coordinator before you receive them. Do not enter any additional information in this section. The following forms have been included:

1. Johnson Lake Phase 2 GICS and STORET application information. (The STORET baseline description was developed during Phase 1 but has been included in the Phase 2 application.) Three baseline stations were used. Only station 1 is included in the sample. Two consecutive sampling dates (April 7, 1979 and May 7, 1979) are described.
2. Johnson Lake award information.
3. Johnson Lake quarterly update. Only station 2 monitoring information for April 12, 1981 is included.

GICS APPLICATION INFORMATION

FOR EPA USE ONLY										PROGRAM CODE 02		APPLICATION RECEIVED DATE 08			
SERIAL NUMBER 01		54		03		S									
				8		REGION NUMBER 17		05		PROJECT STATE 38		WI			
PROJECT OFFICER G2						LEGISLATIVE AUTHORITY 06				GRANT/RECORD TYPE 04		N			
D SULLIVAN															

GRANT/PROJECT DESCRIPTION 20

JOHNSON LAKE RESTORATION PROJECT

PHASE CODE 87

2

TOTAL COST 28

666667

GRANT AMOUNT REQUESTED OF EPA 19

333334

PROJECT LAKE NAME 61

JOHNSON LAKE

PROJECT CITY NAME 39

KNAUVERVILLE

COUNTY NAME 18

WALTON

SURVEY LIST RANKING 59

4

SURVEY YEAR 57

78

APPLICANT NAME 12

WISCONSIN DEPT OF NATURAL RESOURCES

STREET ADDRESS OR P.O. BOX 51

4610 UNIVERSITY AVE PO BOX 450

CITY NAME 14

MADISON

STATE 13

WI

ZIP CODE 32

53701

REPRESENTATIVE 111

GARY BERGER

WATER QUALITY MANAGEMENT PLANNING AGENCY 36

WALTON COUNTY REG PLANNING COMMIS

DUMMY RECORD

PROBLEM DESCRIPTION

AQUATIC WEEDS, ALGAL BLOOMS, HYPOLIM OX
 DEPLET THREATEN WATERSPORTS/NUTRIENTS FROM
 AGRI, SEDS, AND WASTEWATER

OBJECTIVE

REDUCE NUTRIENT INPUT

RESTORATIVE ACTIVITY 0

1 HYPOLIM AERAT
 2 WEED HARVEST
 3 BANK STABILIZ
 4 MANURE STORAG

CODE

04
 13
 18
 16

COST

220563
 123582
 322522
 0

5

6

7

8

9

10

SIGNATURE OF PERSON COMPLETING FORM

608 543-8291

PHONE NO.

GICS AWARD INFORMATION

FOR EPA USE ONLY															PROGRAM CODE 02																													
SERIAL NUMBER 01										54					AMENDMENT DESIGNATOR 03										REGION NUMBER 17					PROJECT STATE 38														
213427										01					0										05					WI														
PROJECT OFFICER G2															EPA GRANTS ASSISTANT															LEGISLATIVE AUTHORITY 06														
D S U L L I V A N															J N 37 (A3)															3 L														
AWARD DATE v6															EPA FUNDS AWARDED THIS ACTION 31															GRANT/RECORD TYPE 04														
800527															333334															N														
PROJECT PERIOD 27															BUDGET PERIOD 18																													
800701830630															800701830630																													
TOTAL COST 28															EPA PROJECT COST 29																													
666667															333334																													

[illegible]

APPLICANT NAME																														
W	I	S	C	O	N	S	I	N	D	E	P	T	O	F	N	A	T	U	R	A	L	R	E	S	O	U	R	C	E	S

ADDRESS 31

4	6	1	0		U	N	I	V	E	R	S	I	T	Y		A	V	E	P	O		B	O	X		4	5	0
---	---	---	---	--	---	---	---	---	---	---	---	---	---	---	--	---	---	---	---	---	--	---	---	---	--	---	---	---

CITY 14 STATE 13 ZIP 52

M A D I S O N W I 5 3 7 0 /

REPRESENTATIVE															
G	A	R	Y		B	E	R	G	E	R					

DUMMY RECORD

RESTORATIVE ACTIVITY								CODE	COST	PROJECTED START	PROJECTED COMPLETION	
1	H	Y	P	O	L	I	M	A	E	R	A	T
2	C	H	A	N	G	E						
3	B	A	N	K	S	T	A	B	I	L	I	Z
4	M	A	N	U	R	E	S	T	O	R	A	G
5												
6												
7												
8												
9												
10												

SIGNATURE OF PERSON COMPLETING FORM

Art. 10

PHONE NO. 608 543-8291

SIGNATURE OF PERSON COMPLETING FORM

PHONE NO. 608 543-8291

[illegible]

Ed Lake

SIGNATURE OF PERSON COMPLETING FROM

608 543-8291

NAME

GICS QUARTERLY UPDATE

FOR EPA USE ONLY		PROGRAM CODE 02	
		[S]	
SERIAL NUMBER 01	AMENDMENT DESIGNATOR 03	REGION NUMBER 17	PROJECT STATE 38
[][][][][]	[][] []	[][]	[][]
PROJECT OFFICER		LEGISLATIVE AUTHORITY 06	
[][][][][][][][][][][][][][]		[][]	

[illegible]

APPLICANT NAME 12
W I S C O N S I N D E P T O F N A T U R A L R E S O U R C E S

ADDRESS 31
4610 UNIVERSITY AVE PO BOX 450

CITY 14 STATE 13 ZIP 52

MADISON WI 53701

[illegible]

CUMULATIVE PAYMENTS REQUESTED TO DATE:

NON EPA

3	0	2	/	2	2			
---	---	---	---	---	---	--	--	--

EPA									
3	0	2	1	2	2				

RESTORATIVE ACTIVITY	Q	CODE	ACTUAL COST	ACTUAL START	ACTUAL COMPLETION
1 HYPOLIM AERAT		04	302122	8106	8109
2 CHANGE					
3 BANK STABILIZ		18		8104	
4 MANURE STORAG		16		8106	
5					
6					
7					
8					
9					
10					

[illegible]

DATE 8/10/30 SIGNATURE OF PERSON COMPLETING FORM Ed Lape PHONE NUMBER 608 543-8291

STORET MONITORING INFORMATION

FOR EPA USE ONLY									
AGENCY CARD (A CARD)									
INDIVIDUAL STORING DATA: NAME, LOCATION, AGENCY, TELEPHONE									
RES-ION		(BLANK)		UN-LOCATING		(BLANK)		(BLANK)	
6 7 - 8 9		1 2 3 4 5 6 7 8 9 10 11 12		1 2 3 4 5 6 7 8 9 10 11 12		1 2 3 4 5 6 7 8 9 10 11 12		1 2 3 4 5 6 7 8 9 10 11 12	
1 2 C L K		E D L A K E C I M C I M M A T I		0 1 6 0 8 - 5 4 3 - 2 8 9 1 E P A		6 1 6 2		7 3 7 4	
7 7 7 8 7 9 8 0		A							
STATION DESCRIPTION (COMPLETE ONLY FOR NEW MONITORING STATIONS)									
STATION TYPE CARD (T CARD)									
STATION CARD (S CARD)									
LATITUDE/LONGITUDE CARD (HEADER CARD 8)									
MAJOR/MINOR BASIN CARD (HEADER CARD 3)									
LOCATION DESCRIPTION CARD (HEADER CARD 4)									
LAKE OR STREAM NAME / PROJECT LAKE									

W. L. J.
SIGNATURE OF PERSON COMPLETING FORM

608 543-8291

Appendix H

TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS

FEDERAL/REGIONAL PROGRAMS

Federal Level: Department of Agriculture Agricultural Stabilization and Conservation Service (ASCS)

1. *Water Bank Program.* Project grants, advisory services and counseling are available under ten-year agreements made with landowners and operators of specified types of wetlands in designated migratory waterfowl nesting and breeding areas. The landowners must agree not to drain, burn, fill or otherwise destroy the wetland character of such areas nor to use the areas for agriculture. Participants must undertake needed land and water management measures.

Grants have ranged from \$4 to \$55 per acre. FY 80 estimated obligations are \$10,000,000.

The program is announced through news media and letters to eligible participants in designated areas. The applicant must develop an approved conservation farm plan with the local Soil and Water Conservation District. Once the plan has been developed, proof of compliance is required. Ten-year agreements may be renewed if mutually agreed to at the rates offered by the Secretary of Agriculture. The ASCS county committee must approve applications within the county allocation of Federal funds for that purpose. No deadlines for application have been established.

Contact: Information can be obtained from the county ASCS office or the state ASCS office.

2. *Rural Clean Water Program.* Cost-shared grants are available to test administrative, engineering and management systems designed to improve water quality in rural areas, for example, by cleaning up animal wastes.

Grants are funded at a maximum rate of 75%

of project cost. The maximum amount provided is \$50,000 per application. Contracts must be signed covering three to ten years. Estimated FY 80 obligations are \$50,000,000.

Contact: Information can be obtained from the county ASCS office or the State ASCS office.

3. *Agricultural Conservation Program (ACP).* Project grants are available to individuals or groups establishing approved conservation practices on agricultural land. The program works to help solve critical soil, water, woodland, and pollution abatement problems on farms and ranches. Responsibility for upkeep and maintenance rests with program participants. Assistance is not available for projects primarily designed to bring new land into production. Payment rates range from 30 to 90 percent depending on priority of the proposed conservation practices. Individual agreements have ranged from \$3 to \$3,500 with the average being \$573. Pooled agreements have ranged as high as \$10,000. ACP funds have been awarded to individual farmers or ranchers whose conservation practices have been supported at the 50 percent level by the Environmental Protection Agency's Clean Lakes Program. FY 80 estimated obligations are \$190,000,000.

Any person who is an owner, landlord, tenant, or sharecropper on a farm or ranch and who bears part of the cost of an approved conservation practice may apply for cost-share assistance under this program. Funds are available to farmers and ranchers in all States, Puerto Rico and the Virgin Islands.

Eligible persons may make applications at any time of the year with approval or disapproval normally taking 30 to 60 days. The ASCS county

committee must approve applications at least in part within the county allocation of Federal funds for that purpose.

Contact: Information can be obtained from the county ASCS office or the state ASCS office.

Farmers Home Administration (FmHA)

1. *Farm Ownership Loans.* Guaranteed/insured loans are available under this program to be used for providing water and water facilities, providing basic soil treatment and land conservation measures, providing financial assistance for recreational enterprises on farms, for buying and developing land to be used for forestry purposes, and for financing pollution abatement and control facilities. Funding limits are \$200,000 for insured loans and \$300,000 for guaranteed loans. The average assistance program is \$60,000, with the range being \$16,000 to \$200,000. FY 80 estimated obligations are \$800,000,000. Repayment schedules may be up to 40 years in length.

Applicants must be unable to obtain adequate credit from other sources at reasonable terms, be a U.S. citizen and possess legal capacity to incur the loan obligations, show debt repayment ability and reliability, managerial ability, and have the necessary experience, training and managerial ability to operate a family farm or a nonfarm enterprise. Other restrictions on combined indebtedness of the applicant apply. Assistance is authorized for all States, Puerto Rico, the Virgin Islands, Guam, American Samoa, and the northern Mariana Islands.

Certification as to the eligibility of the applicant is made by a local county committee of three persons. Applications are considered by the committee within 30 days from the date of application. Loan application for a guaranteed loan is made with the lender.

Contact: Inquiries should be made with the county FmHA office. Information can also be obtained from State FmHA offices.

2. *Irrigation, Drainage and Other Soil and Water Conservation Loans.* Guaranteed/insured loans are available for irrigation, drainage or other soil conservation measures serving farmers or rural residents. Repayment of the loans may be made over a period of up to 40 years. Financial assistance has ranged from \$32,000 to \$612,000 with an average of \$254,210. FY 80 obligations are estimated to be \$7,400,000.

Public or quasi-public bodies and not-for-profit corporations serving open country and rural towns up to 10,000 population may apply for these loans. The applicant must be unable to obtain needed funds from other sources at reasonable rates or terms and must have the legal capacity to borrow, repay and pledge security for the loans and to operate any facilities or services being developed. The proposed project must primarily serve farmers or other rural residents. Assistance is available in all States, Puerto Rico, the

Virgin Islands, Guam, American Samoa, and the northern Mariana Islands.

Up to 60 days is required for review of project proposals by State, metropolitan and local units of government before an application is filed. Applications are subject to State and areawide clearinghouse review. An environmental impact assessment and environmental impact statement are required for this program.

Contact: Applicants should contact their county FmHA member or the FmHA State office.

3. *Recreation Facility Loans.* Guaranteed/insured loans are available to develop land and water resources; repair and construct buildings; purchase land, equipment, livestock and related recreational items; and pay the necessary operating expenses for recreational enterprises. Campgrounds, stables, swimming, tennis and shooting facilities, vacation lodging, lakes and ponds for recreational uses, docks, nature trails, hunting facilities and winter sports areas may utilize these loans. Financial assistance has ranged from \$20,000 to \$100,000. FY 80 estimated obligations are \$2,400 000.

Farm and ranch owners or tenants who wish to convert all or a portion of their farms into outdoor recreational enterprises to supplement or supplant income are eligible for these loans.

The applicant must be unable to obtain adequate credit from other sources at reasonable terms, be a U.S. citizen and possess legal capacity to incur the obligations of the loan. The applicant must also show repayment ability; reliability and managerial ability and industry; be engaged in farming; have the experience or training to be successful in the proposed recreational enterprise; and meet certain other credit and total indebtedness restrictions.

Eligibility certification is made by a local county committee of three persons. Applications are considered by the committee within 30 days from the date of application. Application for the guaranteed loan is filed with the lender.

Contact: Applicants should contact their local county FmHA office or the appropriate FmHA State office.

4. *Resource Conservation and Development Loans (RC&D Loans).* Under this program, guaranteed/insured loans are available for rural community public outdoor waterbased recreational facilities, soil water development conservation control and use facilities, shift-in-land use facilities, community water storage facilities, and special purpose equipment to carry out the above purposes. The project must be located in an authorized RC&D area. A loan for a single RC&D measure cannot exceed \$500,000. Average project assistance has been \$82,000 with the range from \$2,400 to \$250,000. FY 80 estimated obligations are \$2,400,000. Sponsoring public agencies and local nonprofit corporations in authorized RC&D areas may be eligible for loan as-

sistance if they have authority to borrow funds, repay the loan and pledge security for the loan and operate the facilities and services provided and are financially sound and able to provide efficient service. Assistance is authorized in approved RC&D areas in all States, Puerto Rico and the Virgin Islands.

Applications are subject to State and areawide clearinghouse review. An informal preapplication conference is recommended and an environmental impact assessment is required. Approval or disapproval by the FmHA State director normally requires 30 to 90 days.

Contact: Inquiries should be directed to the FmHA county or district office. Information can also be obtained from the appropriate FmHA State office.

5. Soil and Water Loans (SW Loans). Guaranteed/insured loans are available for carrying out basic land treatment practices; establishing pastures and farm forest; improving irrigation; developing water supplies for home use and livestock; acquiring water rights; restoring and repairing ponds, tanks, ditches and canals for irrigation; digging ditches and installing drain tile; developing ponds and water control structures for fish production; and carrying out pollution controls and abatements on farms. Loans which are scheduled for repayment over periods of up to 40 years have averaged \$17,000 per project and have ranged from \$3,300 to \$100,000. FY 80 estimated obligations are \$53,000,000.

Individual farm owners and tenants, eligible farming partnerships-cooperatives or domestic corporations are eligible for loans providing they are unable to obtain credit from other sources under reasonable terms and conditions. Applicants must be United States citizens and have the legal capacity to incur the obligations of the loan; must show repayment ability, reliability, managerial ability and industry; and have the necessary experience, training and managerial ability to carry out the proposed operation. Other total indebtedness restrictions apply to this project. Assistance may be given to eligible applicants in all States, Puerto Rico, the Virgin Islands, Guam, American Samoa, and the northern Mariana Islands.

Eligibility certification is made by a local county committee of three persons with applications being considered by the committee within 30 days from date of application.

Contact: Inquiries should be directed to the FmHA county office or the appropriate FmHA State office.

6. Water and Waste Disposal Systems for Rural Communities. Project grants and guaranteed/insured loans are available for the installation, repair, improvement, or expansion of rural water facilities or waste disposal facilities including the collection and treatment of sanitary, storm and solid wastes. Loans have ranged from \$50,000 to

\$20,917,000 with an average of \$499,445. Grants have ranged from \$5,000 to \$3,500,000, the average being \$273,545. FY 80 estimated obligations are \$700,000,000 for loans and \$300,000,000 for grants. Funds are eligible for joint funding with other eligible Federal programs as specified in OMB Circular No. A-111 regulations. Grants may not exceed 75 percent of eligible project development costs.

Municipalities, counties and other political subdivisions of a State; associations; cooperatives; not-for-profit organizations; and federally-recognized Indian tribes are eligible for assistance provided the service area does not include any city or town with a population greater than 10,000. The applicant must be unable to finance the project without outside assistance and must have the legal authority to construct, operate and maintain the proposed facility and obtain, secure and repay the proposed loan. Assistance is authorized for rural areas in all States, Puerto Rico and the Virgin Islands.

Preapplications are subject to State and areawide clearinghouse review. Standard application forms are required. Plans and specifications must comply with State and local health and pollution regulations. An environmental impact assessment is required. Approval/disapproval time normally takes from 30-90 days.

Contact: Applicants should contact their local county FmHA office.

7. Watershed Protection and Flood Prevention Loans. Guaranteed and insured loans are available to help sponsors provide the local share of the cost of watershed works of improvement for flood prevention, irrigation, drainage, water quality management, sedimentation control, fish and wildlife development, public water-based recreation, and water storage and related costs. Total outstanding loans for any one watershed cannot exceed \$10,000,000. Loans have ranged from \$4,000 to \$5,450,000 with an average of \$318,000. FY 80 estimated obligations are \$20,000,000.

Applicants must be a sponsoring local nonprofit organization operating within the watershed area with authority under State law to obtain, give security for and raise revenues to repay the loan. Assistance is available in all States, Puerto Rico and the Virgin Islands.

Applications are subject to State and areawide clearinghouse review. An environmental impact statement is required. Approval/disapproval time normally takes 30-90 days.

Contact: Inquiries should be directed to the FmHA county office in which the watershed is located.

8. Business and Industrial Loans. Guaranteed/insured loans are available under this program for financial assistance by FmHA or in joint financing with other Federal, State, private, and quasi-public financial institutions. Loans are

made to business and industry to help in improving the economic and environmental climate in rural communities. This includes pollution abatement and the conservation, development and utilization of water for agriculture. A series of restrictions relating to the impact of the proposed project on the employment and production characteristics of the applicant are required. FmHA insured loans may be made in connection with the funds provided by the applicant or other sources. Matching funds are not required. Applicants are required to provide a minimum of 10 percent equity. The range of financial assistance varies from \$11,000 to \$33,000,000, with an average of \$824,000. FY 80 estimated obligations are \$1,000,000,000.

Applicants may be a cooperative corporation, partnership, or other legal entity organized and operated on a profit or nonprofit basis, an Indian tribe, a municipality, county or other political subdivision of a State, or an individual in rural areas. Assistance is available in all States, Puerto Rico, the Virgin Islands, Guam, American Samoa or the northern Mariana Islands, in areas other than cities having a population of more than 50,000 or areas adjacent to urbanized and urbanizing areas with a population density of more than 100 persons per square mile.

Applications are subject to State and areawide clearinghouse review. An environmental assessment and environmental impact statement are required. Final approval by the State director normally requires 60 to 90 days.

Contact: Applicants should contact their local county FmHA office or the appropriate FmHA State office.

9. Area Development Assistance Planning Grants. Under this program, project grants are available for the development of comprehensive planning for rural areas, for revising existing plans and/or for insuring an integrated useable package to support the development of some aspect of a comprehensive planning process. Special consideration is given to those planning efforts which affect the unemployed, the underemployed, those with low family incomes, or minorities. Grants normally range from \$3,750 to \$50,000, with the average FY 79 grant being \$35,000. FY 80 estimated obligations are \$6,000,000. Grants may not exceed 75 percent of the total funds required for the planning project. The grantee's 25 percent share may be met by cash, services or a combination of both. Funds are eligible for joint funding with other eligible Federal programs as specified in OMB Circular No. A-111 regulations.

Local governmental units, substate district organizations, areawide comprehensive planning agencies, regional and local planning commissions, State governments, federally-recognized Indian tribes, and public quasi-public or private nonprofit organizations having authority to pre-

pare comprehensive plans for rural development are eligible for these funds. However, the applicant must have authority to receive and spend Federal and other funds and to contract for planning purposes. The area covered may not include any area in any city or town which has a population of more than 10,000 people.

Preapplication forms must be submitted to county or State FmHA offices. Notice of action taken on preapplication will be within 45 days of date of receipt. Applications are submitted to the FmHA national office and are subject to State and areawide clearinghouse review. An environmental impact assessment is required.

Contact: Applicants should contact their local county FmHA office or the appropriate FmHA State office for information.

Forest Service

1. Forestry Research. Project grants are available for research in the fields of timber management, watershed management, forest range management, wildlife habitat management, and other forest-related areas. Grants have ranged from \$2,000 to \$100,000, with \$20,000 being the average. FY 80 estimated obligations are \$2,500,000. Funds are eligible for joint funding with other eligible Federal programs as specified in OMB Circular No. A-111 regulations. The applicant's contribution is negotiated.

Applicants must certify that they are a nonprofit institution of higher education or a nonprofit organization whose primary purpose is the conduct of scientific research. Grants may be made to State agricultural experiment stations, state and local governments, U.S. territories, nonprofit institutions or organizations.

A complete research proposal explaining in detail the work to be undertaken must be submitted. Proposals from State agencies or organizations must be coordinated with a governor-appointed coordinating agency. Coordination is not required on applications from other sources. Approval or disapproval normally takes 120 days.

Contact: Initial contact for grants should be made to directors of regional experiment stations or the director of the forest products laboratory.

2. Cooperative Forestry Assistance. Grants are available under this program to assist in the advancement of forest resources management on nonfederal forest lands. The improvement and maintenance of fish and wildlife habitat, producing and distributing tree seeds and seedlings, and reforestation are examples of appropriate uses of these grants. Typical programs have ranged from \$40,000 to \$5,000,000 with the average program receiving \$800,000. FY 80 estimated obligations are \$36,188,000.

Landowners of nonfederal lands, rural community fire fighting forces, urban and municipal

governments and other State and local agencies acting through State foresters or equivalent State officials may receive these funds. State forestry or equivalent state agencies in all States, the District of Columbia, Puerto Rico, the Virgin Islands, the northern Mariana Islands, the trust territories of the Pacific Islands, and the territories and possessions of the United States are eligible. This program is considered suitable for joint funding with closely related Federal programs in accordance with OMB Circular No. A-111.

Applications are made by the States to the Forest Service. Approval or disapproval time ranges from 10 to 30 days. Applications are subject to State and areawide clearinghouse review. An environmental impact statement is required whenever pesticides are to be used.

Contact: Regional and area State and private forestry offices of the Forest Service can supply information concerning this program.

Science and Education Administration

1. *Agricultural Research — Basic and Applied Research (RMA Act — Agricultural Omnibus Bill)*. Project grants are available for making agricultural research discoveries and for evaluating alternative ways of attaining goals. Patents resulting from research are available for licensing without charge. The program is also designed to disseminate technical information. Results of the research are available to the public upon request after public disclosure. Previous research has included the development of management practices for removal of nutrients from municipal wastewater and water conservation through irrigation scheduling schemes. Grants have ranged from \$15,000 to \$113,500. The average has been \$75,132. FY 80 estimated obligations are \$195,000.

For grants, only nonprofit institutions of higher education or nonprofit organizations with the primary purpose of conducting scientific research are eligible. All persons are eligible for receiving technical information including those located in the U.S. territories.

A grant review board considers each proposal, evaluating applicant qualifications in line with research to be undertaken.

Contact: Information may be obtained from the Science and Education Administration regional offices. In Washington, D.C., contact the Department of Agriculture, Science and Education Administration, Washington, D.C. 20250, (202) 436-8403.

2. *Cooperative Forestry Research (McIntire-Stennis Act)*. Formula grants are available for forestry research at certified State institutions. Among the categories which can be included in this research are the management of forest and related watershed lands to protect resources against floods and erosions; the management of forest for outdoor recreation; and the improve-

ment of food and habitat for wildlife. Financial assistance to State institutions has ranged from \$24,923 to \$342,588, with an average of \$158,333. FY 80 estimated obligations are \$9,700,000.

State institutions must be certified as eligible by a State representative designated by the governor of each State. The program is available in all States as well as Guam, Puerto Rico and the Virgin Islands.

Funds can be expended only on projects approved by the Science and Education Administration.

Contact: Department of Agriculture, Science and Education Administration, Washington, D.C. 20250, (202) 447-4423.

Soil Conservation Service

1. *Great Plains Conservation*. Cost-share funds are available in the form of direct payments for enduring soil and water conservation measures determined to be needed to protect and stabilize farm or ranching units against climatic and erosion hazards of the Great Plains area. Measure must be applied in accordance with a conservation plan for the entire operating unit. Auxiliary features may be included in the plan for agriculture-related pollution abatement, enhancement of fish, wildlife and recreational resources and promotion of economic use of land. Up to \$25,000 per landowner or operator is available for a contract period running from three to ten years. In FY 79, the average payment was estimated to be approximately \$10,000. FY 80 estimated obligations are \$10,263,000 for direct payments and \$8,426,000 for salaries, expenses and other costs. Cost sharing to participant ranges from 80 percent of the cost (in case of urgently needed work for land stabilization) to 30 percent.

Applicants must have control of the land for the period of the contract running from a minimum of three years to a maximum of ten years.

Application is made to the Soil Conservation Service District conservationist serving the county in which the operating unit is located. The multi-county area conservationist or the area in which the participating county is located serves as the contracting officer. Approval or disapproval time depends upon volume of applications, backlog of pending applications and SCS staff availability.

Contact: Contact the State conservationist for the Soil Conservation Service in the ten Great Plains States where the program operates for more information. District conservationists for SCS can also be contacted.

2. *Resource Conservation and Development*. Project grants are available to assist local people in RC&D areas in initiating and carrying out long-range programs of resource conservation and development. Technical and financial assistance is available for the planning and installation of approved measures specified in RC&D area

plans for such purposes as flood prevention, sedimentation and erosion control, public water-based recreation, fish and wildlife developments, agricultural water management, water quality management, and control and abatement of agriculture-related pollution. Local or State agencies must provide land rights needed for the installation of all measures except for recreation and fish and wildlife developments where financial assistance may be available for up to 50 percent of the cost of land rights acquisition. RC&D assistance may be provided for up to 100 percent of construction costs of flood prevention measures. Local or State agencies generally must provide for 50 percent of construction costs of agriculture water management, fish and wildlife and recreation structures, and must provide for operation and maintenance and for all needed water rights. Loan assistance may be provided for the local share of measure cost. Range of financial assistance has been \$2,000 to \$250,000 with an average of \$50,000. FY 80 estimated obligations are \$2,943,000.

State and local governments and nonprofit organizations with authority to plan or carry out activities related to resource use and development in multi-jurisdictional areas are eligible for these funds. This program is available in all States, Puerto Rico and the Virgin Islands.

Applications are subject to State and areawide clearinghouse review. Standard application forms are required. An environmental impact statement may be required if the proposed measures are likely to significantly affect the quality of the environment, create significant public interest, or result in controversy.

Contact: Information can be obtained from State and field offices of the Soil Conservation Service. For loans, contacts should be made with the Farmers Home Administration office serving the county in which the project will be located.

3. Watershed Protection and Flood Prevention (Small Watershed or PL-566 Program). Project grants, advisory services and counseling are available for the planning, designing and installing of watershed works. Funds are available to share the cost of flood prevention, irrigation, drainage, sedimentation control, and public water-based fish and wildlife and recreation programs. For construction costs, program funds may pay 100 percent for flood prevention, up to 50 percent of agricultural water management, public recreation and fish and wildlife projects, and none of the costs for certain other nonagricultural water management purposes. All of applicant's installation costs are eligible for program loans. Reimbursable advances are available for preservation of sites and future municipal water supply. Projects have ranged in size from \$20,000 to \$13,000,000 with an average of \$2,000,000. FY 80 estimated obligations are \$167,524,000 for watershed and flood preven-

tion programs and \$10,500,000 for watershed planning.

Any State agency, county or group of counties, municipality, town or township, Soil and Water Conservation District, flood prevention or flood control district, or nonprofit agency with authority under State law to carry out, maintain and operate watershed works are eligible for assistance under this program. Watershed area must not exceed 250,000 acres. The program is available in all States, Puerto Rico and the Virgin Islands.

Potential applicants must notify State planning and development clearinghouses that they intend to apply for assistance. Up to 60 days is allowed for review. Applications are subject to State and areawide clearinghouse review. Environmental impact statements are required on all projects determined to be Federal action that significantly affects the environment.

Contact: Information may be obtained from the Soil Conservation Service State office. At the Federal level, information may be obtained from the Department of Agriculture, Administrator, Soil Conservation Service, P. O. Box 2890, Washington, D.C. 20013, (202) 447-4531.

4. Plant Materials for Conservation. This program offers the sale, exchange or donation of plant materials to be used in all phases of the soil and water conservation program. Over 140 varieties of grasses, legumes and shrubs are readily available for conservation purposes through this program. Uses include erosion control, sediment reduction, roadside and streambank protection, surface mined land reclamation, wildlife food and cover, and beautification.

Cooperating State and Federal agencies and cooperators of conservation districts interested in field testing plants for conservation purposes are eligible for this program. The program is available in all States, Puerto Rico and the Virgin Islands.

Applications are made to the local Soil Conservation Service office.

Contact: For information concerning this program, contact the Technical Service Centers, the Soil Conservation Service State offices and the Soil Conservation Service field offices. Federal level information may be obtained from the Department of Agriculture, Administrator, Soil and Conservation Service, P.O. Box 2890, Washington, D.C. 20013, (202) 447-4531.

5. Resource Appraisal and Program Development (Resources Conservation Act — RCA). Under this project, grants and technical information are available relating to the appraisal of natural resources, development or updating of conservation district programs that utilize RCA generated information and for carrying out State and national RCA activities. In FY 79, projects' grants ranged from \$13,000 to \$122,000, with an aver-

age of \$45,000. FY 80 estimated obligations for salaries and expenses are \$4,309,000. Grants are not available for FY 80.

Soil and water conservation agencies, local conservation districts and other appropriate State natural resource agencies may be eligible for funds under this program. Puerto Rico and the Virgin Islands conservation districts also may apply.

A grant agreement approved by the Soil Conservation Service State conservationist must be signed between the administering agency in the State and the SCS. When available, funds are committed by the SCS State conservationist.

Contact: Inquiries should be directed to the Soil Conservation Service State office.

6. Rural Abandoned Mine Program (RAMP). Direct payments for specified use and advisory services are available for conservation practices determined to be needed for the reclamation, conservation and development of up to 370 acres per owner of rural abandoned coal mine lands and waters affected by coal mining activities. Eligible projects are limited to practices that will provide land stabilization, erosion and sediment control, and development of soil, water, woodland, wildlife, reclamation resources and agricultural productivity of such lands. This program may cost-share up to 80 percent, depending on the income-producing potential of the reclaimed land. For acreages in excess of 120 acres, the cost-sharing rate is reduced by up to 0.25 percent per acre. Initially, cost-share rates will range from 25 to 100 percent. The range of projects is from \$5,000 to \$196,000, with an average of \$100,000. FY 80 estimated obligations are \$2,685,000.

Persons, groups or units of government who control or own surface or water rights of abandoned coal lands and water affected by coal mining before August 3, 1977, are eligible to apply for these services and funds.

The applicant must develop a reclamation plan with the assistance of the Soil Conservation Service. Public entities are subject to State and areawide clearinghouse review. Reclamation by individual land users on private land is excluded from such review. An environmental impact assessment is required.

Contact: Inquiries concerning this program should be made to the local office of the Soil Conservation Services.

Federal Level: Department of Commerce Economic Development Administration

1. Economic Development — Grants and Loans for Public Works and Development Facilities. Project grants and direct loans are available under this program to assist in the construction of public facilities needed to initiate and encourage long-term economic growth in designated geographic areas where such growth is lagging be-

hind the rest of the Nation. Included in the qualified public facilities are water and sewer systems. The basic grant rate may be up to 50 percent of the project cost. Severely depressed areas that cannot match Federal funds may receive supplementary grants to bring the Federal contribution up to 80 percent of the project cost. Designated Indian reservations are eligible for 100 percent assistance. Financial assistance has ranged from \$5,000 to \$7,138,000 with the average being \$580,000. FY 80 estimated obligations are \$196,005,000 for grants, no funds available for loans. This program is considered suitable for joint funding with closely related Federal financial assistance programs as specified in OMB Circular No. A-111.

States, local subdivisions thereof, Indian tribes, and private or public nonprofit organizations or associations representing a redevelopment area or a designated Economic Development Center are eligible for grants and loans under this program.

Preapplication coordination takes place between the Economic Development Administration representative and the applicant and community leaders. A preapplication conference may be required. Applications are subject to State and areawide clearinghouse review. Environmental impact assessments and statements are necessary. Normally approval or disapproval occurs within 90 days of acceptance of the application.

Contact: Information can be obtained from the EDA regional offices or from the Department of Commerce, Office of Public Investments, Economic Development Administration, Washington, D.C. 20230, (202) 377-5265.

2. Economic Development — Public Works Impact Projects. Project grants are available under this program for the construction of public facilities such as water and sewer systems. The basic grant rate for special impact areas is 80 percent except for Indian areas where the rate can be 100 percent. The local matching share may be waived if the appropriate entity can demonstrate that it has exhausted its effective taxing and/or borrowing capacity. Priority is given to projects of \$600,000 or less. The average project has received \$220,000. This program is suitable for joint funding with closely related Federal financial assistance programs, in accordance with the provisions of OMB Circular No. A-111.

States and their local subdivisions, Indian tribes and private or public nonprofit organizations representing a redevelopment area for an economic development center are eligible for this program.

Preapplication coordination takes place between the Economic Development Administration representative and the applicant and community leaders. A preapplication conference may be required. Applications are subject to

State and areawide clearinghouse review. Environmental impact assessments and statements are necessary. Approval or disapproval generally occurs within 90 days of acceptance of the application.

Contact: Information can be obtained from the regional or local office of the Economic Development Administration.

3. Grants to States for Supplemental and Basic Funding of Titles I, II, III, IV, and IX Activities (Section 304 Grants). Project grants and direct loans are available under this program to construct such public works as water and sewer systems. The intent of the program is to provide funds which will enable governors to select projects which will assist in the construction of public facilities and other projects which meet the criteria of Titles I, II, III, IV, and IX and are needed to initiate or enhance long-term economic growth in areas of their States where such growth is lagging. The State must make a contribution equal to at least 25 percent of the 304 funds used for supplemental grants and direct grants or loans. Financial assistance has ranged from \$1,000 to \$976,000. FY 80 estimated obligations are \$20,000,000.

This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with the provisions of OMB Circular No. A-111.

States, local and subdivisions, Indian tribes, and private or public nonprofit organizations or associations representing a designated redevelopment area or center are eligible to receive public works grants and loans.

Governors select projects to be funded from the moneys allocated to their jurisdictions. After selection by the governors, the eligibility and compliance of the project for assistance is determined by the regional director of the Economic Development Administration. Applicants must prepare and submit profile information and preapplication forms. State and areawide clearinghouse reviews are required. Environmental assessments are required to determine if an environmental impact statement is needed. Approval or disapproval normally takes 90 days after a governor has submitted a proposal.

Contact: Information on this program can be obtained from the State Economic Development or information agency or from the appropriate regional office of the Economic Development Administration.

Federal Level: Department of Education Office of Education

1. Environmental Education. Project grants are available to support research, development, pilot and demonstration projects designed to improve public understanding of environmental issues as they relate to the quality of life. Such projects shall support the development of edu-

cational processes dealing with man's relationship with his natural and man-made surroundings and include such topics as the relationship of pollution to the total human environment. Supportable activities include development of curriculum material, training for educational and noneducational personnel, community education projects, and elementary and secondary education programs. This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. The range of financial assistance has been \$7,000 to \$150,000 with an average of \$42,700. FY 80 estimated obligations for grants are \$3,500,000. The Federal dollar contribution to any project under this program will not exceed 80 percent of the project cost for the first year, 60 percent of the first year project cost for the second year and 40 percent of the first year project cost for the third year. The exception are general projects for evaluation, dissemination, curriculum development and workshop projects which are eligible for 100 percent funding.

Applicants for grant awards may be institutions of higher education, State or local educational agencies and other public and nonprofit private agencies, organizations and institutions including libraries and museums who have been organized and active for at least one year.

Standard application forms are furnished by the agency. Applications are subject to State and areawide clearinghouse review. Application deadlines are published in the Federal Register, with the approval or disapproval requiring four to five months.

Contact: Guideline priorities and funding criteria are available from Department of Education, Office of Environmental Education, Washington, D.C. 20202, (202) 245-9231. Applications must be sent to the Department of Education, Application Control Center, Washington, D.C. 20202.

Federal Level: Department of Housing and Urban Development

Community Planning and Development

1. Comprehensive Planning Assistance (701). Project grants are available under this program to strengthen planning and decisionmaking capabilities of State chief executives, local governments and areawide planning organizations. A broad range of planning and management activities may be supported by these grants including the improvement, development and implementation of comprehensive plans incorporating land use and housing elements. The program is suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. FY 80 estimated obligations are \$42,500,000. The State may apply for these funds for planning assis-

tance to local governments for State, interstate, metropolitan, district, or regional activities. Grants may not exceed two-thirds of the cost of the assisted project.

Local governments, counties, and non-metropolitan areawide planning organizations generally apply through their State planning agencies. Other applicants having special planning needs may apply directly to the appropriate HUD regional and area office or voluntarily agree to apply through the State. Applications are subject to State and areawide clearinghouse review. An environmental assessment must be prepared when the program will result in development plans or policies for land use, major community facilities, utility and transportation systems, or the protection of natural areas. A historic preservation assessment is required of all developmental plans or programs likely to have an effect on historic preservation areas. Application deadlines are set pursuant to an annual department schedule for administrative actions. Time between applications and approval or disapproval normally is three months.

Contact: Information may be obtained from the appropriate HUD area office concerning this program.

2. Community Development Block Grants/Entitlement Grants. Under this program, formula grants are available for cities to undertake a wide range of activities directed toward neighborhood revitalization, economic development, and provision of improved community facilities and services. Specific activities that can be carried out with Block Grant funds include acquisition of real property, provision of public facilities and improvements such as water and sewer facilities, streets and neighborhood centers. Block Grant funds are available to pay for certain public services which are necessary or appropriate to support other Block Grant activities. Cities have the discretion to design programs and establish priorities for the use of funds so long as programs conform to the statutory standards and program regulations. Community Block Grant funds have been used in some cases to provide the local matching share for Clean Lakes Programs. All projects or activities must either principally benefit low and moderate income persons, aid in the prevention or elimination of slums and blight, or meet other community development needs having a particular urgency. Entitlements are based on a formula using factors of population, overcrowded housing, extent of poverty, age of housing and growth lag. FY 80 estimated obligations for grants are \$2,753,838,000.

Cities with SMSA's in excess of 50,000 population, urban counties, and cities with population under 50,000 which are central cities in SMSA's are entitled to receive funds as determined by a statutory formula.

Environmental impact statements are necessary for this program. Applications are subject to State and area clearinghouse review. Every year the localities submit an Annual Community Development Program, an Annual Housing Action Program, a series of certifications regarding other Federal requirements. Every third year, localities submit a community development and housing plan and a housing assistance plan. Applications are approved in the HUD area office and must be submitted according to published schedule. Approval or disapproval time is normally within 75 days.

Contact: Information may be obtained from the appropriate HUD area office concerning this program.

3. Community Development Block Grant/Small Cities Program (Small Cities). Under this program, project grants are available to assist communities in providing a suitable living environment and expanded economic opportunities principally for persons with low or moderate incomes. Acquisitions, rehabilitation or construction of public works facilities such as water and sewer, which affect public health or safety, are among the activities funded under this program. It is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. Single purpose or comprehensive programs can be funded. In 1978, the average single purpose program received \$284,000 while the average comprehensive program received \$500,000. FY 80 estimated obligations are \$929,662,000.

All States, counties and units of general local government, except metropolitan cities and urban counties, may apply for small cities grants.

The applicant must file a preapplication. This will result in an invitation to submit a full application if it rates high enough. Full application will be reviewed to assure that it meets all requirements, including an acceptable strategy for meeting the needs of low and moderate income families. An environmental impact statement is necessary. Applications are subject to State and areawide clearinghouse review and must be submitted according to the published regulations schedule. Notification of approval or disapproval normally will be within 75 days.

Contact: Information concerning this program may be obtained from the appropriate HUD area office.

Federal Level: Department of the Interior

Office of Surface Mining Reclamation and Enforcement

1. Regulation of Surface Coal Mining and Surface Effects of Underground Coal Mining. Project grants and direct payments are available under this program to protect society and the environment from adverse affects of surface coal mining

operations. Grants are available for preparation of permanent program applications to the Office of Surface Mining Reclamation and Enforcement, for incremental State costs of enforcing Federal interim standards, equipment needs, permanent program development, and many other aspects of regulating surface impacts of coal mining. Small operator assistance is limited to paying the cost of determining probable hydrologic consequences in a statement of the results of test borings and core samples. Technical assistance is available on any aspect of regulating surface impacts of coal mining. Permanent program development grants are limited to 80 percent of costs in the first year, 60 percent in the second, and 50 percent thereafter. Interim program grants range from \$38,200 to \$2,133,000 with an average of \$290,329. Program development grants have ranged from \$20,000 to \$1,565,600 with an average of \$378,134. FY 80 estimated obligations are \$22,680,000 for interim program grants, \$4,000,000 for program development grants and \$25,000,000 for small operator assistance.

State governor-designated agencies, small operators and coal mining operations are eligible for funding under this program. Eligibility for small operator assistance is determined by production of less than 100,000 tons of coal annually at all mining locations.

Small operators are required to submit assistance applications. For State grants, approval of Office of Surface Mining Reclamation and Enforcement Headquarters or by the Office of Surface Mining Reclamation and Enforcement regional directors is required. Both the State and small operator applications must meet specific criteria described in the Federal Register, Volume 42 Number 239 dated Tuesday, December 13, 1977. Estimated time for approval or disapproval is one to three months.

Contact: Copies of regulation and applications are available from the Department of the Interior, Office of Surface Mining Reclamation and Enforcement, Washington, D.C. 20240. Other information may be obtained from the State grants and small operator assistance office and technical assistance from the technical services and research office.

Heritage Conservation and Recreation Service

1. *Outdoor Recreation — Acquisition, Development and Planning (Land and Water Conservation Fund Grants)*. Project grants are available to provide for the preparation of comprehensive statewide outdoor recreation plans and acquisition and development of outdoor recreation areas and facilities for the general public. The grants may be used for a wide range of outdoor recreation projects such as picnic areas, inner-city parks, campgrounds, tennis courts, boat launching ramps, bike trails, and support facilities such as roads and water supply. Facilities

must be open to the general public and not limited to special groups. Development of basic facilities rather than elaborate facilities is favored. Grants are also available to States for revising and updating existing State outdoor recreation plans, preparation of new plans, and for statewide surveys, technical studies, data collection, and analysis. The program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. Not more than 50 percent of project cost may be federally financed for projects using grants under this program. However, under certain conditions, all or part of the project sponsor's matching share may be from certain other Federal assistance programs such as Title One community development, Appalachian and all other regional commissions. Financial assistance under this program has ranged from \$150 to \$5,450,000 with an average of \$68,178. FY 80 estimated obligations are \$300,000,000.

For planning grants, only the State agency formally designated by the governor or State law as responsible for the preparation and maintenance of the statewide comprehensive outdoor recreation plan is eligible to apply. For acquisition and development grants, the designated agency may apply for assistance for itself or on behalf of other State agencies or political subdivisions such as cities, counties and park districts. Indian tribes which are organized to govern themselves and perform the function of a municipal government also qualify for assistance.

Project proposals are submitted to this agency through the State liaison officer designated by the governor. Proposals are reviewed by the regional office where final action is taken. Applications are subject to State and areawide clearing-house review. The applicant is required to furnish basic environmental information or evaluation. An environmental impact statement may be required. Approximately 120 days are needed following the application for approval or disapproval of acquisition and development projects, 60 days for planning projects.

Contact: Information may be obtained from the regional offices of the Heritage Conservation and Recreation Service or from the Department of the Interior, Division of State Programs, Heritage Conservation and Recreation Service, Washington, D.C. 20243, (202) 343-7801.

2. *Urban Park and Recreation Recovery Program*. Project grants are available to economically hard-pressed communities for rehabilitation of existing indoor and outdoor recreation facilities, demonstration of innovative ways to enhance park and recreation opportunities and development of recreation plans. Rehabilitation funds may be used to improve park landscapes, buildings and support facilities and can be used for up to 70 percent of the project if 30 percent is sup-

plied locally. Innovation grants (also available for up to 70 percent of the project) can cover costs of personnel, facilities, equipment, supplies or services designed to demonstrate innovative, cost-effective ways to enhance park and recreation opportunities at the neighborhood level. Recovery action program grants can be used for up to 50 percent of the development of local park and recreation system recovery plans. State, local and private funds, as well as Federal General Revenue Sharing (Treasury Department) and Community Development Block Grant (Department of Housing and Urban Development) program funds may be used as a part of the local match. FY 80 estimated obligations are \$125,000,000.

Eligible cities and counties must meet certain need, economic and physical distress and condition of urban recreational facilities and systems requirements. Jurisdictions within SMSA's may apply for these funds even though they do not meet the eligibility requirements if their requests are in accord with the intent of this program.

Preapplications are submitted to the appropriate HCRS Regional office. Proposals are reviewed by the regional office and certified if they meet legal standards. Certified proposals are evaluated and ranked three times a year, with the highest priority proposals submitted to HCRS in Washington, D.C., for further review and ranking. Applications are subject to State and areawide clearinghouse review. Approval or disapproval normally requires up to 30 days. The formal application process must be completed within 120 days of notification of the tentative grant offer.

Contact: Information may be obtained from the regional offices of the Heritage Conservation and Recreation Service or from the Department of the Interior, Heritage Conservation and Recreation Service, Urban Programs, 440 G Street N.W., Washington, D.C. 20243, (202) 343-5791.

Water and Power Resources Service (formerly Bureau of Reclamation)

1. *Small Reclamation Projects (Small Project Loans)*. Project grants and direct loans are available to public nonfederal organizations for rehabilitation and betterment or construction of water resource development projects. Projects can be single-purpose irrigation or drainage or multipurpose including flood control, fish and wildlife, recreational development, municipal and industrial water supplies. Construction grants can be made for costs allocated to flood control and for a portion of the costs allocated to fish and wildlife enhancement and recreation development. The applicant must prepare the loan application report, and provide water rights and rights-of-way costs. Loans have ranged from \$700,000 to \$17,000,000 with an average of \$8,200,000. FY 80 estimated obligations are \$46,879,000 for grants and loans.

Applicant must file notice of intent to apply for a loan with the appropriate regional office of the Service. Applications are subject to State and areawide clearinghouse review. Copies of the notice must also be forwarded to local offices of the Fish and Wildlife Service, Corps of Engineers for flood control, the Environmental Protection Agency and State clearinghouse. An environmental impact assessment is required. Engineering and economic application reports are prepared by the applicant with assistance, if needed, from the appropriate regional office of the Service. Approval or disapproval generally takes more than one year.

Contact: Information may be obtained from the regional directors of the Service or from the Department of the Interior, Senior Staff Assistant for Water Operations, Water and Power Resources Service, Washington, D.C. 20240, (202) 343-5471.

U.S. Fish and Wildlife Service

1. *Fish Restoration (Dingell-Johnson Program or D-J Program)*. Under this program, formula grants are available to support projects designed to restore and manage sport fish populations for the preservation and improvement of sport fishing and related uses. Approved activities include land acquisition, development, research and coordination. Projects are reimbursed for up to 75 percent of the total cost. No State may receive more than 5 percent or less than 1 percent of the total apportioned. Forty percent is allocated on the basis of land and water area of the State and 60 percent on the basis of paid fishing license holders. Financial assistance has ranged from \$271,000 to \$1,355,000 in 1971, with the average being \$501,850. FY 80 estimated obligations are \$30,417,772.

Participation is limited to State fish and wildlife agencies in States that have passed laws for the conservation of fish including the prohibition against diversion of license fees paid by fishermen for purposes other than the administration of the State fish and wildlife agency.

Standard application forms are furnished by the agency. Applications are subject to State and areawide clearinghouse review. Environmental assessments are required where actions significantly affect the human environment. Grantee may document the initial program by submission of a satisfactory comprehensive long-range plan or a project application. Average approval or disapproval time is 8 days after the application is made.

Contact: Information may be obtained from the regional offices of the U.S. Fish and Wildlife Service.

2. *Wildlife Restoration (Pittman-Robertson Program or P-R Program)*. Formula grants are available under this program to support projects for restoring or managing wildlife populations

and the provision of public use of these resources or the provision of facilities and surveys for hunter safety programs. Approved activities include land acquisition, development, research, and coordination. States may be reimbursed up to 75 percent of the total project cost. No State may receive more than 5 percent or less than one-half of one percent of the total apportioned. Fifty percent of the apportionment is based on the land area of the States and fifty percent on the basis of paid license holders. Project financial assistance has ranged from \$466,880 to \$3,886,480 in FY 79, with an average of \$1,522,200. FY 80 estimated obligations are \$93,974,102 for grants.

Participation is limited to State fish and wildlife agencies in States that have passed laws for the conservation of wildlife including a prohibition against diversion of license fees paid by hunters for purposes other than administration of the State fish and wildlife agency. Puerto Rico, Guam and the Virgin Islands are also eligible.

Standard application forms are furnished by the agency. The grantee may document the initial program by submitting a satisfactory comprehensive long-range plan or by submitting a project application furnished by the Service. Environmental assessment is required where actions will significantly affect the human environment. Applications are subject to State and areawide clearinghouse review. Regional director approves or disapproves the comprehensive long-range plan and individual proposed projects in an average of 8 days of receipt of the proposal.

Contact: Information may be obtained from the district offices of the U.S. Fish and Wildlife Service.

Federal Level: Department of Transportation

Coast Guard

1. *Pollution by Oil and Hazardous Substances — Liability.* Section 311 (k) of the Federal Water Pollution Control Act (as amended by Clean Water Act of 1977) established a revolving fund in the Treasury at a level of \$35 million for the purpose of carrying out the provisions of subsections (c), (d), (i), and (l) of the Act. Those subsections authorize the Coast Guard or its delegate to remove or arrange for removal of any oil or hazardous substance discharged into or upon the navigable waters of the United States, adjoining shorelines, or waters of the contiguous zone. That authority may also act whenever it determines that there is a substantial threat of such a discharge. Rules and regulations concerning control of pollution by oil and hazardous substances, discharge removal, and liability were published in the Federal Register on March 25, 1976 (41 FR 12628). The regulations prescribe notification procedures in event of an oil or haz-

ardous substance discharge, the procedures for the removal of a discharge of oil, and the costs that may be imposed or reimbursed for the removal of a discharge of oil or hazardous substance. Subsection (k) authorizes appropriation of such sums as may be necessary to keep the Pollution Fund at a level of \$35 million.

Contact: Coast Guard district offices and EPA regional offices.

Federal Level: Small Business Administration

1. *Water Pollution Control Loans (WPC).* Direct loans and guaranteed/insured loans are provided to qualified small businesses for making additions to or alterations in their equipment and facilities including the construction of pretreatment facilities and interceptor sewers or their methods of operation to comply with Water Pollution Control requirements established under the Federal Water Pollution Control Act. Loans will be limited to \$500,000 unless substantial hardship is proven. SBA share of guaranteed loans may not exceed 90 percent. Financial assistance has ranged from \$5,687 to \$470,000 with an average of \$124,510.

Applicants must be a small business concern likely to suffer economic injury in complying with requirements established under the Federal Water Pollution Control Act. The program is available to each State, the District of Columbia and all territories and possessions of the United States.

Applicant must submit necessary information to the regional administrator of the Environmental Protection Agency to allow evaluation and issuance of a statement that such additions or alterations are necessary and adequate to comply with the Federal Water Pollution Control Act. Applications are filed with the Small Business Administration field office serving the area where the business is located. The EPA review is completed within 45 days of the receipt of the completed application unless a public hearing is necessary.

Contact: Information may be obtained from the regional administrator of the Environmental Protection Agency.

2. *Regulatory Loans (REGO).* Direct loans and guaranteed/insured loans are available to assist a small business concern in making additions to or alterations in its plant, facilities or methods of operation to meet requirements imposed by any Federal law or by any State or local law. Personal and business assets and other means of obtaining credit at reasonable terms must be utilized where feasible. Maximum Small Business Administration guarantee is 90 percent.

Most small businesses that suffer substantial economic injury as a result of any regulation or order described above are eligible for assistance under this program.

Financial action can be taken on an application any time after an authorized government agency has imposed an order and certified that the proposed changes constitute compliance. Applications are filed in the field office of the Small Business Administration serving the territory in which the applicant's business is located. Approval requires approximately 30 days from date of application acceptance.

Contact: Information may be obtained from the field offices of the Small Business Administration or from the Small Business Administration, Office of Disaster Loans, 1441 L Street Northwest, Washington, D.C. 20416, (202) 653-6830.

3. Business Pollution Control Financing Guarantee (Pollution Control Financing). Guaranteed/insured loans are available to help small businesses meet pollution control requirements and remain competitive. Financial assistance has been given up to \$5,000,000 with \$1,000,000 being the approximate average. FY 80 estimated obligations are \$50,000,000. To be eligible, a small business must require pollution control facilities or equipment but be at operational or financial disadvantage for obtaining such, yet have willingness of local bond issuing authority to fund such facilities or equipment through a qualified contract and bond sale with Small Business Administration's guarantee.

The application is prepared in conjunction with the sponsor, the securities underwriter, the bond issuing authority, and the bond legal counsel. Application is made to the Small Business Administration, which requires from 3 to 10 working days for approval or disapproval.

Contact: Information may be obtained from the Small Business Administration, Pollution Control Financing Division, Office of Special Guarantees, 1441 L Street Northwest, Washington, D.C. 20416, (202) 653-6083.

Federal Level: Water Resources Council

1. Water Resources Planning (Title III-Water Resources Planning Program). Under this program, formula grants are available to provide for increased participation by States in water and related land resources planning. The Federal and nonfederal matching share must be for reasonable expenses clearly allocatable to the State comprehensive water and related land resources planning effort. Consultant services are eligible to the extent that development of trained State personnel for comprehensive water and related land resources planning is not impaired. Federal or nonfederal matching shares can be used for expenses, for preparing plans and specifications for construction, or for the actual construction of specific projects. These matching shares can be used for meeting a State's share of the cost of Title II River Basin Commission's or for matching Federal funds under any other Federal aided pro-

gram. This program is considered suitable for joint funding with closely related federal financial assistance programs in accordance with OMB Circular No. A-111. Up to 50 percent of the cost of carrying out an improved State program may be provided by the Council. Assistance programs have ranged from \$37,080 to \$88,400 with an average of \$55,820. FY 80 estimated obligations are \$20,000,000 for grants.

The fifty States, District of Columbia, Puerto Rico, Virgin Islands, Guam, and northern Mariana Islands are eligible for funds under this program. The applicant must be a State agency designated by law or the governor to administer the State's water and related land resources planning.

Standard application forms must be used in this program. Applications are subject to State and areawide clearinghouse review. The director of the Water Resources Council makes final decisions as to approval of applications, which are due 90 days after Council publication (usually February) of tentative allotments to States. Approval or disapproval normally requires 30 to 90 days after receipt of the application.

Contact: Information may be obtained from the Water Resources Council, State Programs Division, 2120 L Street Northwest, Washington, D.C. 20037, (202) 254-6446.

Federal Level: Environmental Protection Agency

Office of Water and Waste Management

1. Construction Grants for Wastewater Treatment Works. Project grants (cooperative agreements) are available for the construction of municipal wastewater treatment works including privately owned individual treatment systems if a municipality applies on behalf of a number of such systems. Such works may serve all or portions of individual communities, metropolitan areas or regions. The project may include but may not be limited to treatment of industrial wastes. The program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. The grant may be for 75 percent of eligible project costs or 85 percent for innovative or alternative technology projects. Programs have ranged from \$675 to \$290,800,000 with an average of \$4,000,000. FY 80 estimated obligations are \$4,400,000,000.

Any municipality, inter-municipal agency, State, or interstate agency having jurisdiction over waste disposal is eligible for assistance under this program. It is available to each State, the District of Columbia, and each territory or possession of the United States.

Preapplication assistance is available through the State water pollution agency or the appropriate EPA regional office. Applications must be submitted through these agencies. Applications

are subject to State and areawide clearinghouse review. An environmental assessment is required which may lead to the requirement for an environmental impact statement. Approval or disapproval normally requires 90 days.

Contact: Information may be obtained from the State water pollution control agency or the appropriate EPA regional office.

2. Water Pollution Control — State and Interstate Program Grants (106 Grants). Formula grants are available under this program for the establishment and maintenance of adequate measures for prevention and control of water pollution. Broad support is available for permitting, pollution control studies, planning, surveillance, and enforcement. Advice and assistance is available to local agencies. Training and public information are also available. Funds cannot be used for construction, operation or maintenance of waste treatment plants nor for costs financed by other Federal grants. This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. Financial assistance has ranged from \$85,400 to \$3,086,000 with an average of \$938,000. FY 80 estimated obligations are \$48,730,000 for grants. State and interstate water pollution control agencies are eligible for funding under this program. It is available to each State, the District of Columbia, and all territories and possessions of the United States.

Informal meetings are held between the regional office and State applicant agency concerning program preparation. Applications are subject to State and areawide clearinghouse review. Completed application forms must be submitted to the appropriate EPA regional office, Grants Administration Branch. Suggested dates of submission are June 1 for draft State/EPA agreements and no later than September 1 for final State/EPA agreements. Approval or disapproval time normally takes 30 days.

Contact: Information may be obtained from the appropriate EPA regional office.

3. Water Pollution Control — State and Areawide Water Quality Management Planning Agency (Section 208 Grants). Project grants are provided to areawide and State planning agencies to develop a water quality management plan for the area or areas approved by the appropriate regional EPA administrator. This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. The Federal assistance rate is 75 percent for all grants. The range of financial assistance has been from \$100,000 to \$4,000,000 with an average of \$440,000. FY 80 estimated obligations are \$40,000,000.

This program is available to a local or regional planning agency designated by the governor or

appropriate local officials and approved by the administrator of EPA as the official areawide waste treatment management planning agency. The program is available to each State, the District of Columbia, and all territories and possessions of the United States.

Preapplication coordination with the appropriate regional EPA office is recommended. Applications are subject to State and areawide clearinghouse review. Standard application forms are furnished by the agency. Grant applications are submitted to the appropriate EPA regional administration office. In the case of an area designated by the governor, the application and supporting data must be submitted by the State reviewing agencies prior to submission to EPA. In interstate cases, the application must be submitted to the governor of the State wherein the greatest portion of the planning area lies. Grant applications must be submitted according to dates established by the regional EPA administrators. Approval or disapproval time normally is 45 days.

Contact: Information may be obtained from the regional EPA offices.

4. State Underground Water Source Protection Program Grants. Under this program project grants are available for the development and implementation of underground injection control programs adequate to enforce the requirements of the State drinking water act. Federal assistance is limited to 75 percent of eligible costs, not to exceed the State allotment. This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. FY 80 estimated obligations are \$7,795,000.

State agencies designated by the governor or the chief executive officer by one of the States, the District of Columbia or any of the U.S. territories or possessions which has been listed by the EPA administrator as requiring an underground injection control program are eligible for funding under this program.

Preapplication coordination with appropriate regional offices is recommended. Grant applications are submitted to the appropriate EPA regional administrator. Applications are subject to State and areawide clearinghouse review. Approval or disapproval time is approximately 45 days.

Contact: Applicants should contact the appropriate EPA regional office for information concerning this program.

5. Solid and Hazardous Waste Management Program Support Grants. Formula grants and project grants are available to assist in the development and implementation of State and local programs and support rural and special communities in programs and projects leading to the solution of solid waste management problems. As-

assistance includes support of facility planning, feasibility studies, expert consultation, surveys and analysis of market needs, marketing of recovered resources, technology assessment, legal expenses, construction feasibility studies, source preparation projects, and fiscal or economic investigation or studies. Funds may be used by special communities for conversion, improvement or consolidation of existing solid waste disposal facilities or for construction of new facilities. Assistance is also available to low population municipalities for closing or upgrading existing open dumps or meeting requirements of restrictions on open burning or other requirements arising under the Clean Air Act or the Federal Water Pollution Control Act. This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. The Federal share of a project may be up to 75 percent although 100 percent may be funded for conducting inventories of open dumps. Financial assistance has ranged from \$71,500 to \$1,318,200 with an average of \$250,000. FY 80 estimated obligations are \$85,050,000. State and substate solid waste agencies, authorities and organizations in all States, the District of Columbia, Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Mariana Islands are eligible for funding under this project.

The standard application forms furnished by the agency are required for this program. Preapplications for resource conservation and recovery projects are solicited in the Commerce Business Daily and evaluated with published criteria. Requests for application forms and completed applications are submitted to the appropriate EPA regional grants administration office. The staff at the appropriate office is available to assist in preparation of the application. Applications are subjected to administrative evaluation to determine adequacy in relation to grant regulations and to technical and program evaluation. Approval or disapproval time ranges from 30 to 90 days depending upon the type of application. Applications are subject to State and areawide clearinghouse review. Environmental impact assessments may be required for implementation projects involving major construction or siting.

Contact: Information may be obtained from the appropriate EPA regional administrator.

6. Solid Waste Management Demonstration Grants. Project grants are available to promote the demonstration and application of solid waste management and resource recovery technology and assistance which preserve and enhance the quality of the environment and conserve resources and to conduct solid waste management and resource recovery studies, investigations and surveys. This program is considered suitable for joint funding with closely related

Federal financial assistance programs in accordance with OMB Circular No. A-111. Resource recovery system demonstration projects may be funded up to 75 percent by this Federal program. Construction of new or improved solid waste disposal facilities serving an area of only one municipality may be funded up to 50 percent of eligible project costs, or 75 percent in any other cases.

State, interstate, municipal, intermunicipal, or other public authorities and agencies are eligible for the various components of this program. In addition, public or private colleges and universities and private nonprofit agencies and institutions are eligible for the resource recovery systems demonstration projects or for the construction of new or improved solid waste disposal facilities. All States, the District of Columbia, Puerto Rico, the Virgin Islands, Guam, American Samoa, and the northern Mariana Islands are eligible for assistance under this program.

Standard application forms are furnished by the agency for this program. Requests for application forms and completed applications are submitted to the Environmental Protection Agency, Grants Administration Division. Applications are subject to State and areawide clearinghouse review. An environmental impact assessment is required only for major demonstration and construction projects. Approval or disapproval time normally takes 90 days.

Contact: Information may be obtained from the appropriate EPA regional office.

Office of Research and Development

1. Environmental Protection — Consolidated Research Grants. Project grants are available under this program to support research to determine the environmental effects and control requirements associated with energy, to identify, develop and demonstrate necessary pollution control techniques, and to evaluate the economic and social consequences of alternative strategies for pollution control of energy systems. Grants may also be used to explore and develop strategies and mechanisms for those in the economic, social, governmental, and environmental systems to use in environmental management. This program is suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. Projects must be cost shared at a minimum of 5 percent. Financial assistance has ranged from \$1,000 to \$1,816,560. FY 79 average financial assistance was \$98,304. FY 80 estimated obligations are \$20,800,000 for grants. This program is available for public and private State universities and colleges, hospitals, laboratories, state and local government departments, other public or private nonprofit institutions, and individuals who have demonstrated unusually high

scientific ability. It is available to each State, territory and possession of the United States including the District of Columbia.

Preapplication discussion with the EPA program office is advisable. Standard application forms must be used. Requests for application forms and completed applications must be submitted to the EPA Grants Administration Division. An environmental impact assessment is required. Approval or disapproval normally takes 90 days.

Contact: Individuals are encouraged to communicate with the appropriate EPA regional office. For information on grant applications and procedures, contact the Environmental Protection Agency, Grants Administration Division, PM-216, Washington, D.C. 20460. For program information, contact the Environmental Protection Agency, Office of Research and Development, RD-674, Washington, D.C. 20460, (202) 755-8787.

2. Solid Waste Disposal Research Grants. Project grants are available to promote and support the coordination of research and development in the area of collection, storage, utilization, and salvage or final disposal of solid waste. The program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. These grants require a minimum of 5 percent cost sharing. Financial assistance has ranged from \$16,000 to \$359,000 with an estimated average in FY 79 of \$80,000. FY 80 estimated obligations are \$2,500,000 for grants.

The program is available to public or private agencies; public, private, State universities and colleges; State and local governments; and individuals in each State, territory and possession of the U.S. including the District of Columbia.

Preapplication discussion with the EPA program office is advisable. Requests for required standard application forms and completed applications must be submitted to the EPA Grants Administration Division. An environmental impact assessment is required. The range of approval or disapproval time is 90 days.

Contact: Individuals are encouraged to communicate with the appropriate EPA regional office. Information concerning grant applications and procedures may be obtained from Environmental Protection Agency, Grants Administration Division, PM-216, Washington, D.C. 20460. Program information may be obtained from the Environmental Protection Agency, Office of Research and Development, RD-674, Washington, D.C. 20460, (202) 755-8787.

3. Water Pollution Control Research, Development, and Demonstration Grants. Project grants are available under this program to support and promote the coordination and acceleration of research, development, and demonstra-

tion projects relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution. The program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111. Grants under certain sections of this program require a minimum of 5 percent cost sharing, while the remainder require 25 percent cost sharing. Research grants have ranged from \$1,000 to \$772,912 in FY 78 and 79 with an average in FY 79 of \$91,710 and a projected average for FY 80 of \$75,000. Demonstration grants have ranged from \$37,506 to \$9,500,000 in FY 78 and 79 with an average of \$131,330 in FY 79. FY 80 projected demonstration grant average is \$100,000. FY 80 estimated obligations are \$17,668,000 for research and demonstration grants.

This program is available to public, private, State and community universities and colleges, hospitals, laboratories, State water pollution control agencies, interstate agencies, State and local governments, other public or private nonprofit agencies, institutions, and organizations in each State and all territories and possessions of the United States including the District of Columbia. Grants may be awarded to individuals who have demonstrated unusually high scientific ability. Grants under certain sections of this program may be awarded to profit-making organizations.

Preapplication discussion with the EPA program office is advisable. Requests for the required standard application forms and completed applications must be submitted to the Environmental Protection Agency, Grants Administration Division. Demonstration grant applications are subject to State and areawide clearinghouse review. An environmental impact assessment is required for this program. Range of approval or disapproval time is 90 days.

Contact: Individuals are encouraged to communicate with appropriate EPA regional office. Information concerning grant applications and procedures may be obtained from the Environmental Protection Agency, Grants Administration Division, PM-216, Washington, D.C. 20460. Program information may be obtained from the Environmental Protection Agency, Office of Research Program Management, RD-674, Washington, D.C. 20460, (202) 755-8787.

Office of Planning and Management

1. Loan Guarantees for Construction of Treatment Works. Guaranteed/insured loans are available to assist and serve as an incentive in construction of municipal sewage treatment works which are required to meet State and Federal water quality standards. The program is designed to insure that inability to borrow necessary funds from other sources on reasonable terms does not prevent the construction of any wastewater treatment works for which a grant

has been or will be awarded. Applications for loan guarantees will be limited to financing certain portions of the eligible and allowable local share of a grant for construction of wastewater treatment works. EPA guarantees the loan from the Federal Financing Bank.

A State, interstate agency, a municipality, or an intermunicipal agency which has applied for a construction grant under Title II of the Clean Water Act or which has committed itself to finance the local share of any project for which a grant has been awarded or for which an application is being processed is eligible for funds under this program. It is available to each State, territory and possession of the United States including the District of Columbia.

Preapplication consultation with the appropriate EPA Regional Construction Grants and Grant Administration Offices is recommended. Application is made through the State agency to the appropriate EPA regional office. Fees are charged for processing of the application and for issuance of a commitment to guarantee. If the application is approved by the EPA administrator, loan guaranteed contracts will be issued to the Federal financing office which disperses funds.

Contact: Contact the appropriate regional office of the EPA for information concerning this program or Environmental Protection Agency, Grants Administration Division, PM-216, Washington, D.C. 20460, (202) 755-0850.

Regional Level: Appalachian Regional Commission

1. *Appalachian Regional Economic Development.* Grant funds are available to assist the Appalachian region in preparing economic development plans, and in promoting economic development through public and private investment. The program works as a joint Federal-State partnership through the Commission, which represents selected counties in Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia.

The thirteen Appalachian states are eligible for funds under the program. Proposed projects must be consistent with the region's comprehensive long-range economic development plan. Costs are determined in accordance with Federal Management Circular 74-4 for State and local governments.

Application must be submitted through the State alternate to the Appalachian Regional Commission, which is composed of the governors of the member States and a Federal co-chairman. An environmental impact statement is required. Decisions on policy, procedures, and the allocation of funds are made by the Commission.

Contact: Executive Director, Appalachian Regional Commission, 1666 Connecticut Avenue Northwest, Washington, D.C. 20235, (202) 673-7874.

2. *Appalachian State Research, Technical Assistance, and Demonstration Projects.* Project grants are available to sponsor research (including investigations, studies, and demonstration projects) or to demonstrate the feasibility of plans and programs for concerted economic and social development in the region. The grants are available to the Appalachian States (Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia) and local public bodies in the designated counties of those States.

Grants ranged from \$3,000 to \$2,000,000, averaging \$137,953. FY 79 obligations were estimated at \$10,300,000 and FY 80 obligations are estimated to be \$12,000,000.

Application must be submitted through the Appalachian State Alternates Office. Projects must relate to the needs identified in the State Appalachian Plan and Investment Program. Approval or disapproval usually comes within 30 to 60 days after the receipt of the application by the Commission.

Contact: Executive Director, Appalachian Regional Commission, 1666 Connecticut Avenue Northwest, Washington, D.C. 20235, (202) 673-7874.

3. *Appalachian Supplements to Federal Grant-In-Aid (Supplemental Grant Program).* Grant-in-aid supplements provide a portion of the local share of Federal grant-in-aid programs in the Appalachian region when the economic situation of the community precludes it from supplying its matching share. These supplements can be used on programs for the construction or equipping of facilities and the acquisition of land. Eligible States are: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia.

This program is suitable for joint funding with closely related Federal assistance programs as specified in OMB Circular A-111 regulations. Costs will be determined in accordance with Federal Management Circular 74-4 for State and local governments, but the Federal government will not supply more than 80% of the eligible project costs.

States apply for the Federal grant-in-aid with the appropriate Federal agency and obtain determination of the distribution of Federal and local shares of financing. The project application must be approved by the governor of the State in which the project is located. Applications must go through the governor's office for Commission assistance. Upon State approval, the Commission determines the level of participation in

the project. Time from application to approval or disapproval ranges from 30 to 60 days.

Contact: Executive Director, Appalachian Regional Commission, 1666 Connecticut Avenue Northwest, Washington, D.C. 20235, (202) 673-7874.

Regional Level: Coastal Plains Regional Commission

1. Coastal Plains Regional Economic Development. Grant funds are available to assist the Coastal Plains region in preparing economic development plans, and in promoting economic development through public and private investment. The program works as a joint Federal-State partnership through the Commission, which represents designated counties in North Carolina, South Carolina, Georgia, Florida, and Virginia.

The five Coastal Plains states are eligible for funds under the program. Proposed projects must be consistent with the region's comprehensive long-range economic development plan. Costs are determined in accordance with Federal Management Circular 74-4 for State and local governments.

Application must be submitted through a member of the Coastal Plains Regional Commission, which is composed of the governors of the member States and a Federal co-chairman. An environmental impact Statement is required. Decisions on policy, procedures, and the allocation of funds are made by the Commission. Approval or disapproval of projects usually comes 60 to 90 days after application.

Contact: Federal Co-chairman, Coastal Plains Regional Commission, Suite 413, 1725 K Street Northwest, Washington, D.C. 20006, (202) 634-3910.

2. Coastal Plains Technical and Planning Assistance. Grant funds are available to the States in the Coastal Plains region (North Carolina, South Carolina, Georgia, Florida, and Virginia) to assist economic programs. Eligible programs include studies to evaluate the needs of the region, research and planning, economic development potential, and demonstration projects and training programs.

Grants ranged from \$2,500 to \$450,000, averaging \$45,000. FY 79 obligations were estimated at \$2,800,000 and FY 80 obligations are estimated to be \$2,800,000.

Applications must be submitted through the governor's representative to the Coastal Plains Regional Commission. Projects must relate to the needs identified in the Commission's Comprehensive Economic Development Plan. Approval or disapproval usually comes within 60 to 90 days of the date of application.

Contact: Federal Co-chairman, Coastal Plains Regional Commission, Suite 413, 1725 K Street

Northwest, Washington, D.C. 20006, (202) 634-3910.

3. Coastal Plains Supplements to Federal Grant-In-Aid (Supplemental Grant Program). Grant-in-aid supplements provide a portion of the local share of Federal grant-in-aid programs in the Coastal Plains region when the economic situation of the community precludes it from supplying its matching share. These supplements can be used on programs for the construction or equipping of facilities and the acquisition of land. Eligible States are: Georgia, North Carolina, South Carolina, Florida, and Virginia.

This program is suitable for joint funding with closely related Federal assistance programs as specified in OMB Circular A-111 regulations. Costs will be determined in accordance with Federal Management Circular 74-4 for State and local governments, but the Federal government will not supply more than 80% of the eligible project costs.

States apply for the Federal grant-in-aid with the appropriate Federal agency and obtain determination of the distribution of Federal and local shares of financing. The project application must be approved by the governor of the State in which the project is located. Applications must go through the governor's office for Commission assistance. Upon State approval, the Commission determines the level of participation in the project. Time from application to approval or disapproval ranges from 60 to 90 days.

Contact: Federal Co-chairman, Coastal Plains Regional Commission, 1725 K Street Northwest, Suite 413, Washington, D.C. 20006, (202) 634-3910.

Regional Level: Four Corners Regional Commission

1. Four Corners Regional Economic Development. Grant funds are available to assist the Four Corners region in preparing economic development plans, and in promoting economic development through public and private investment. The program works as a joint Federal-State partnership through the Commission, which represents States in the Four Corners region including Arizona, Colorado, New Mexico, Nevada, and Utah.

The five Four Corners States are eligible for funds under the program. Proposed projects must be consistent with the region's comprehensive long-range economic development plan. Costs are determined in accordance with Federal Management Circular 74-4 for State and local governments.

Application must be submitted through a member of the Four Corners Regional Commission, which is composed of the governors of the member States and a Federal co-chairman. An environmental impact statement is required. Decisions on policy, procedures, and the allocation

of funds are made by the Commission. Approval or disapproval of projects usually comes 30 to 60 days after application.

Contact: Executive Director, Four Corners Regional Commission, 2350 Alamo Southeast, Suite 303, Albuquerque, New Mexico 87106, (505) 766-2990.

2. Four Corners Technical and Planning Assistance. Grant funds are available to the States in the Four Corners region (Arizona, Colorado, New Mexico, Nevada, and Utah) to assist economic programs. Eligible programs include studies to evaluate the needs of the region, research and planning, economic development potential, and demonstration projects and training programs.

Grants ranged from \$1,770 to \$200,000, averaging \$20,000. FY 79 obligations were estimated at \$1,600,000 and FY 80 obligations are estimated to be \$3,700,000.

Applications must be submitted through the governor's representative to the Four Corners Regional Commission. Projects must relate to the needs identified in the Commission's Comprehensive Economic Development Plan. Approval or disapproval usually comes within 30 to 60 days of the date of application.

Contact: Four Corners Regional Commission, 2350 Alamo Southeast, Suite 303, Albuquerque, New Mexico 87106, (505) 766-2990.

3. Four Corners Supplements to Federal Grant-In-Aid (Supplemental Grant Program). Grant-in-aid supplements provide a portion of the local share of Federal grant-in-aid programs in the Four Corners region when the economic situation of the community precludes it from supplying its matching share. These supplements can be used on programs for the construction or equipping of facilities and the acquisition of land. Eligible states are: Arizona, Colorado, New Mexico, Nevada, and Utah.

This program is suitable for joint funding with closely related Federal assistance programs as specified in OMB Circular A-111 regulations. Costs will be determined in accordance with Federal Management Circular 74-4, but the Federal government will not supply more than 80% of the eligible project costs.

States apply for the Federal grant-in-aid with the appropriate Federal agency and obtain determination of the distribution of Federal and local shares of financing. The project application must be approved by the governor of the State in which the project is located. Applications must go through the governor's office for Commission assistance. Upon State approval, the Commission determines the level of participation in the project. Time from application to approval or disapproval ranges from 30 to 60 days.

Contact: Four Corners Regional Commission, 2350 Alamo Southeast, Suite 303, Albuquerque, New Mexico 87106, (505) 766-2990.

Regional Level: New England Regional Commission

1. New England Regional Economic Development. Grant funds are available to assist the New England region in preparing economic development plans, and in promoting economic development through public and private investment. The program works as a joint Federal-State partnership through the Commission, which represents Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

The six New England States are eligible for funds under the program. Proposed projects must be consistent with the region's comprehensive long-range economic development plan. Costs are determined in accordance with Federal Management Circular 74-4 for State and local governments.

Application must be submitted through a member of the New England Regional Commission, which is composed of the governors of the member States and a Federal co-chairman. An environmental impact statement is required. Decisions on policy, procedures, and the allocation of funds are made by the Commission. Approval or disapproval of projects usually comes 30 to 60 days after application.

Contact: Office of Federal Co-chairman, New England Regional Commission, Suite 400, 53 State Street, Boston, Massachusetts 02109, (617) 223-6045.

2. New England Technical and Planning Assistance. Grant funds are available to the States in the New England region (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont) to assist economic programs. Eligible programs include studies to evaluate the needs of the region, research and planning, economic development potential, and demonstration projects and training programs.

Grants ranged from \$1,000 to \$150,000, averaging \$87,000. FY 79 obligations were estimated at \$6,200,000 and FY 80 obligations are estimated to be \$6,069,000.

Applications must be submitted through the governor's representative to the New England Regional Commission. Projects must relate to the needs identified in the Commission's Comprehensive Economic Development Plan. Approval or disapproval usually comes within 60 to 90 days of the date of application.

Contact: Office of Federal Co-chairman, New England Regional Commission, Suite 400, 53 State Street, Boston, Massachusetts 02109, (617) 223-6045.

3. New England Supplements to Federal Grant-In-Aid (Supplemental Grant Program). Grant-in-aid supplements provide a portion of the local share of Federal grant-in-aid programs in the New England region when the economic situa-

tion of the community precludes it from supplying its matching share. These supplements can be used on programs for the construction or equipping of facilities and the acquisition of land. Eligible States are: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

This program is suitable for joint funding with closely related Federal assistance programs as specified in OMB Circular A-111 regulations. Costs will be determined in accordance with Federal Management Circular 74-4 for State and local governments, but the Federal government will not supply more than 80% of the eligible project costs.

States apply for the Federal grant-in-aid with the appropriate Federal agency and obtain determination of the distribution of Federal and local shares of financing. The project application must be approved by the governor of the State in which the project is located. Applications must go through the governor's office for Commission assistance. Upon State approval, the Commission determines the level of participation in the project. Time from application to approval or disapproval ranges from 30 to 90 days.

Contact: Office of the Federal Co-chairman, New England Regional Commission, 53 State Street, Suite 400, Boston, Massachusetts 02109, (617) 223-6045.

Regional Level: Old West Regional Commission

1. Old West Regional Economic Development. Grant funds are available to assist the Old West region in preparing economic development plans, and in promoting economic development through public and private investment. The program works as a joint Federal-State partnership through the Commission, which represents Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

The five Old West States are eligible for funds under the program. Proposed projects must be consistent with the region's comprehensive long-range economic development plan. Costs are determined in accordance with Federal Management Circular 74-4 for State and local governments.

Application must be submitted through a member of the Old West Regional Commission, which is composed of the governors of the member States and a Federal co-chairman. An environmental impact statement is required. Decisions on policy, procedures, and the allocation of funds are made by the Commission. Approval or disapproval of projects usually comes 30 to 60 days after application.

Contact: Old West Regional Commission, Hedden-Empire Building, Suite 228, Billings, Montana 59101, (406) 657-6665.

2. Old West Technical and Planning Assistance. Grant funds are available to the States in the Old West region (Montana, Nebraska, North Dakota, South Dakota, and Wyoming) to assist economic programs. Eligible programs include studies to evaluate the needs of the region, research and planning, economic development potential, and demonstration projects and training programs.

Grants ranged from \$1,000 to \$4,500,000, averaging \$60,000. FY 79 obligations were estimated at \$6,700,000 and FY 80 obligations are estimated to be \$5,700,000.

Applications must be submitted through the governor's representative to the Old West Regional Commission. Projects must relate to the needs identified in the Commission's comprehensive economic development plan. Approval or disapproval usually comes within 30 to 60 days of the date of application.

Contact: Old West Regional Commission, Hedden-Empire Building, Suite 228, Billings, Montana 59101, (406) 657-6665.

3. Old West Supplements to Federal Grant-In-Aid (Supplemental Grant Program). Grant-in-aid supplements provide a portion of the local share of Federal grant-in-aid programs in the Old West region when the economic situation of the community precludes it from supplying its matching share. These supplements can be used on programs for the construction or equipping of facilities and the acquisition of land. Eligible States are: Montana, Nebraska, North Dakota, South Dakota, and Wyoming.

This program is suitable for joint funding with closely related Federal assistance programs as specified in OMB Circular A-111 regulations. Costs will be determined in accordance with Federal Management Circular 74-4 for State and local governments, but the Federal government will not supply more than 80% of the eligible project costs.

States apply for the Federal grant-in-aid with the appropriate Federal agency and obtain determination of the distribution of Federal and local shares of financing. The project application must be approved by the governor of the State in which the project is located. Applications must go through the governor's office for Commission assistance. Upon State approval, the Commission determines the level of participation in the project. Time from application to approval or disapproval ranges from 30 to 60 days.

Contact: Old West Regional Commission, Hedden-Empire Building, Suite 228, Billings, Montana 59101, (406) 657-6665.

Regional Level: Ozarks Regional Commission

1. Ozarks Regional Economic Development. Grant funds are available to assist the Ozarks region in preparing economic development plans,

and in promoting economic development through public and private investment. The program works as a joint Federal-State partnership through the Commission, which represents Arkansas, Kansas, Louisiana, Missouri, and Oklahoma.

The five Ozarks States are eligible for funds under the program. Proposed projects must be consistent with the region's comprehensive long-range economic development plan. Costs are determined in accordance with Federal Management Circular 74-4 for State and local governments.

Application must be submitted through a member of the Ozarks Regional Commission, which is composed of the governors of the member States and a Federal co-chairman. An environmental impact statement is required. Decisions on policy, procedures, and the allocation of funds are made by the Commission. Approval or disapproval of projects usually comes 30 to 60 days after application.

Contact: Ozarks Regional Commission, 1100 North University Avenue, Suite 109, Little Rock, Arkansas 72207, (501) 378-5905.

2. Ozarks Technical and Planning Assistance. Grant funds are available to the States in the Ozarks region (Arkansas, Kansas, Louisiana, Missouri, and Oklahoma) to assist economic programs. Eligible programs include studies to evaluate the needs of the region, research and planning, economic development potential, and demonstration projects and training programs.

Grants ranged from \$1,500 to \$250,000, averaging \$35,000. FY 79 obligations were estimated at \$2,200,000 and FY 80 obligations are estimated to be \$1,800,000.

Applications must be submitted through the governor's representative to the Ozarks Regional Commission. Projects must relate to the needs identified in the Commission's Comprehensive Economic Development Plan. Approval or disapproval usually comes within three months of the date of application.

Contact: Ozarks Regional Commission, 1100 North University Avenue, Suite 109, Little Rock, Arkansas 72207, (501) 378-5905.

3. Ozarks Supplements to Federal Grant-In-Aid (Supplemental Grant Program). Grant-in-aid supplements provide a portion of the local share of Federal grant-in-aid programs in the Ozarks region when the economic situation of the community precludes it from supplying its matching share. These supplements can be used on programs for the construction or equipping of facilities and the acquisition of land. Eligible states are: Arkansas, Kansas, Louisiana, Missouri, and Oklahoma.

This program is suitable for joint funding with closely related Federal assistance programs as specified in OMB Circular A-111 regulations. Costs will be determined in accordance with

Federal Management Circular 74-4 for State and local governments, but the Federal government will not supply more than 80% of the eligible project costs.

States apply for the Federal grant-in-aid with the appropriate Federal agency and obtain determination of the distribution of Federal and local shares of financing. The project application must be approved by the governor of the State in which the project is located. Applications must go through the governor's office for Commission assistance. Upon State approval, the Commission determines the level of participation in the project. Time from application to approval or disapproval ranges to three months.

Contact: Ozarks Regional Commission, 1100 North University Avenue, Suite 109, Little Rock, Arkansas 72207, (501) 378-5905.

Regional Level: Pacific Northwest Regional Commission

1. Pacific Northwest Regional Economic Development. Grant funds are available to assist the Pacific Northwest region in preparing economic development plans, and in promoting economic development through public and private investment. The program works as a joint Federal-State partnership through the Commission, which represents Idaho, Oregon, and Washington.

The Pacific Northwest States are eligible for funds under the program. Proposed projects must be consistent with the region's comprehensive long-range economic development plan. Costs are determined in accordance with Federal Management Circular 74-4 for State and local governments.

Application must be submitted through a member of the Pacific Northwest Regional Commission, which is composed of the governors of the member States and a Federal co-chairman. An environmental impact statement is required. Decisions on policy, procedures, and the allocation of funds are made by the Commission. Approval or disapproval of projects usually comes 30 to 90 days after application.

Contact: Pacific Northwest Regional Commission, 700 East Evergreen Boulevard, Vancouver, Washington 98660, (206) 696-7771.

2. Pacific Northwest Technical and Planning Assistance. Grant funds are available to the States in the Pacific Northwest region (Idaho, Oregon, and Washington) to assist economic programs. Eligible programs include studies to evaluate the needs of the region, research and planning, economic development potential, and demonstration projects and training programs.

Grants ranged from \$2,000 to \$1,000,000, averaging \$100,000. FY 79 obligations were estimated at \$6,100,000 and FY 80 obligations are estimated to be \$5,600,000, exclusive of contracts.

Applications must be submitted through the governor's representative to the Pacific Northwest Regional Commission. Projects must relate to the needs identified in the Commission's Comprehensive Economic Development Plan. Approval or disapproval usually comes within 60 to 90 days of the date of application.

Contact: Pacific Northwest Regional Commission, 700 East Evergreen Boulevard, Vancouver, Washington 98660, (206) 696-7771.

Regional Level: Southwest Border Regional Commission

1. *Southwest Border Regional Economic Development.* Grant funds are available to assist the Southwest Border region in preparing economic development plans, and in promoting economic development through public and private investment. The program works as a joint Federal-State partnership through the Commission, which represents designated counties in Arizona, California, New Mexico, and Texas.

The four Southwest Border States are eligible for funds under the program. Proposed projects must be consistent with the region's comprehensive long-range economic development plan. Costs are determined in accordance with Federal Management Circular 74-4 for State and local governments.

Application must be submitted through a member of the Southwest Border Regional Commission, which is composed of the governors of the member States and a Federal co-chairman. An environmental impact statement is required. Decisions on policy, procedures, and the allocation of funds are made by the Commission.

Contact: Southwest Border Regional Commission, 100 North Stone Avenue, Suite 309, Tucson, Arizona 85726, (602) 792-6781.

2. *Southwest Border Technical and Planning Assistance.* Grant funds are available to the States in the Southwest Border region (Arizona, California, New Mexico, and Texas) to assist economic programs. Eligible programs include studies to evaluate the needs of the region, research and planning, economic development potential, and demonstration projects and training programs.

Grants ranged from \$15,252 to \$400,000, averaging \$95,000. FY 79 obligations were estimated at \$600,000 and FY 80 obligations are estimated to be \$6,500,000.

Applications must be submitted through the governor's representative to the Southwest Border Regional Commission. Projects must relate to the needs identified in the Commission's Comprehensive Economic Development Plan. Approval or disapproval usually comes within 30 to 60 days of the date of application.

Contact: Southwest Border Regional Commission, 100 North Stone Avenue, Suite 309, Tucson, Arizona 85726, (602) 792-6781.

Regional Level: Upper Great Lakes Regional Commission

1. *Upper Great Lakes Regional Economic Development.* Grant funds are available to assist the Upper Great Lakes region in preparing economic development plans, and in promoting economic development through public and private investment. The program works as a joint Federal-State partnership through the Commission, which represents selected counties in Michigan, Minnesota, and Wisconsin.

The three Upper Great Lakes States are eligible for funds under the program. Proposed projects must be consistent with the region's comprehensive long-range economic development plan. Costs are determined in accordance with Federal Management Circular 74-4 for State and local governments.

Application must be submitted through a member of the Upper Great Lakes Regional Commission, which is composed of the governors of the member States and a Federal co-chairman. An environmental impact statement is required. Decisions on policy, procedures, and the allocation of funds are made by the Commission. Approval or disapproval of projects usually comes 30 to 90 days after application.

Contact: Upper Great Lakes Regional Commission, c/o University of Wisconsin-Superior, Hawkes Hall, Superior, Wisconsin 54880.

2. *Upper Great Lakes Technical and Planning Assistance.* Grant funds are available to the States in the Upper Great Lakes region (selected counties in Michigan, Minnesota, and Wisconsin) to assist economic programs. Eligible programs include studies to evaluate the needs of the region, research and planning, economic development potential, and demonstration projects and training programs.

Grants ranged from \$300 to \$190,000, averaging \$45,000. FY 79 obligations were estimated at \$2,400,000 and FY 80 obligations are estimated to be \$2,250,000.

Applications must be submitted through the governor's representative to the Upper Great Lakes Regional Commission. Projects must relate to the needs identified in the Commission's Comprehensive Economic Development Plan. Approval or disapproval usually comes within 30 to 90 days of the date of application.

Contact: Upper Great Lakes Regional Commission, c/o University of Wisconsin-Superior, Hawkes Hall, Superior, Wisconsin 54880.

3. *Upper Great Lakes Supplements to Federal Grant-In-Aid (Supplemental Grant Program).* Grant-in-aid supplements provide a portion of the local share of Federal grant-in-aid programs in the Upper Great Lakes region when the economic situation of the community precludes it from supplying its matching share. These supplements can be used on programs for the construction or equipping of facilities and the acqui-

sition of land. Eligible States are: Michigan, Minnesota, and Wisconsin.

This program is suitable for joint funding with closely related Federal assistance programs as specified in OMB Circular A-111 regulations. Costs will be determined in accordance with Federal Management Circular 74-4 for State and local governments, but the Federal government will not supply more than 80% of the eligible project costs.

States apply for the Federal grant-in-aid with the appropriate Federal agency and obtain determination of the distribution of Federal and local shares of financing. The project application must be approved by the governor of the State in which the project is located. Applications must go through the governor's office for Commission assistance. Upon State approval, the Commission determines the level of participation in the project. Time from application to approval or disapproval ranges from 30 to 60 days.

Contact: Upper Great Lakes Regional Commission, c/o University of Wisconsin-Superior, Hawkes Hall, Superior, Wisconsin 54880.

PROGRAMS PROVIDING LABOR

Federal Level: Department of Agriculture

Forest Service

1. *Youth Conservation Corps — Grants to States (YCC)*. Grant funds are provided to assist States in meeting the cost of projects for the employment of young men and women to develop, preserve and maintain nonfederal public lands and waters within the States. Participants must be between the ages of 15 and 18, and must be permanent residents of the United States or its territories.

Contact: Persons are encouraged to communicate with regional foresters or area directors. State foresters or directors of departments of natural resources can also provide information. At the Department of Agriculture, contact the staff director of the Human Resource Programs of the Forest Service, (202) 447-7738.

2. *Young Adult Conservation Corps — Grants to States (YACC)*. Project grants are provided to States for the full cost of projects for the employment of young men and women to do conservation work and other public projects on nonfederal public lands and waters. Persons between 16 and 23 years of age who are unemployed and lawful, permanent residents or citizens of the United States or lawfully admitted refugees or parolees may apply for Corps membership.

Contact: For State programs, information may be obtained from regional foresters or area directors. State foresters and/or State agencies having natural resources and conservation re-

sponsibilities, and the governor's designated YACC program agent are also sources of information.

Federal Level: Department of Labor

Employment and Training Administration

1. *Comprehensive Employment and Training Programs (CETA of 1973, as Amended)*. The Comprehensive Employment and Training Act provides formula grants and project grants for job training and employment opportunities for economically disadvantaged, unemployed and underemployed persons and to assure that training and other services lead to increased earnings and enhance self sufficiency. Under this program, youths can be employed on community planned projects that produce tangible benefits to the community. The projects are organized by private, nonprofit organizations and agencies sensitive to youth needs. Although CETA funds cannot be used as matching funds for the Clean Lakes Program, they can be used to provide supplemental in-kind labor for coordination with the program.

Contact: Information may be obtained from the regional Employment and Training office.

2. *Employment and Training — Indians and Native Americans*. Formula grants are available under this program to use for employment and training programs and services for native Americans. Programs include on-the-job training, public service employment, work experience, youth employment programs, and other job-related training programs. This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with the provisions of OMB Circular No. A-111.

Contact: Information may be obtained from the Department of Labor, Employment and Training Administration, Office of Indian and Native American Programs, 601 D Street Northwest, Washington, D.C. 20213, (202) 376-6102.

3. *Senior Community Service Employment Program (SCSEP)*. Formula grants and project grants in the form of contracts are available to promote useful part-time work opportunities (up to 20 hours per week) in community service activities for low income persons aged 55 years and older who have poor employment prospects. Organizations receiving project grants or contracts may use the funds to create and pay for part-time community service job positions. Individuals employed under this program may be placed in work assignments at established local service agencies or may be given work assignments in connection with newly formed or innovative community service projects. The program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with the provisions of OMB Circular No. A-111.

Contact: Information may be obtained from the Department of Labor, Employment and Training Administration, Office of National Programs, 601 D Street Northwest, Washington, D.C. 20213, (202) 376-6232.

4. Special Programs and Activities for the Disadvantaged. Under this program, project grants are available to provide or arrange for job training and job opportunities for members of groups with particular disadvantages in the general labor market or in certain segments of the labor market. These groups include displaced homemakers, offenders, persons with limited English speaking ability, handicapped persons, younger persons, single persons, older persons, women, minorities, welfare clients, persons lacking educational credentials, and persons dislocated from their jobs as a result of plant closings, natural disasters and like circumstances. Project grants also may be made for a wide variety of promotional, developmental, and research-related activities.

Contact: Information may be obtained from the Department of Labor, Employment and Training Administration, Office of National Programs, 601 D Street Northwest, Washington, D.C. 20213, (202) 376-6225.

Federal Level: Action

1. Retired Senior Volunteer Program (RSVP). Project grants are made to established community service organizations to assist in the development or operation of locally oriented senior volunteer projects. This local community service organization develops a wide variety of volunteer service opportunities throughout the community. Grants may be used for staff salaries and fringe benefits, staff travel, equipment, space costs, and related expenses, and for volunteer out-of-pocket expenses. This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No A-111.

Contact: Information may be obtained from ACTION regional offices and ACTION State program offices or from Older Americans Volunteer Program ACTION, 806 Connecticut Avenue Northwest, Washington, D.C. 20525, (202) 254-7310.

2. Mini-Grant Program (Mini-Grants). Project grants are available to provide small amounts of money (not to exceed \$5,000 per grant) to local, public and private nonprofit organizations for the purpose of mobilizing relatively large numbers of part-time, uncompensated volunteers to work on human, social and environmental needs, particularly those related to poverty. This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111.

Contact: Information may be obtained from the regional offices of ACTION or from the ACTION Office of Voluntary Citizen Participation, Program Operations Division, Suite 907, 806 Connecticut Avenue Northwest, Washington, D.C. 20525, (202) 254-7262.

3. State Office of Voluntary Citizen Participation Programs (S/OVCP). Project grants are available to establish and/or strengthen offices of volunteer services to improve opportunities for volunteer efforts concerned with human, social and environmental needs, particularly those related to poverty. This program is considered suitable for joint funding with closely related Federal financial assistance programs in accordance with OMB Circular No. A-111.

Contact: Information may be obtained by contacting the toll free number 800-424-8867 or ACTION, Office of Voluntary Citizen Participation, Program Operations Division, Suite 907, 806 Connecticut Avenue Northwest, Washington, D.C. 20525, (202) 254-7262.

TECHNICAL ASSISTANCE/INFORMATION PROGRAMS

Federal Level: Department of Agriculture Soil Conservation Service

1. Soil and Water Conservation. Technical assistance is available for carrying out programs of soil and water conservation. Assistance is available to individuals and groups for planning and application of soil and water conservation practices. Technical soil and water conservation information is also furnished to units of government.

Contact: State or Local Soil Conservation Service office or Department of Agriculture, Soil Conservation Service, Box 2890, Washington, D.C. 20013, (202) 447-4531.

2. River Basin Surveys and Investigations. Assistance is available to governmental units in the collection of information regarding water and related land resources. The program is designed to improve national economic development and environmental quality. Special attention is given to best land management practices, and flood control and mitigation.

Contact: State or local Soil Conservation Service office or Department of Agriculture, Soil Conservation Service, Box 2890, Washington, D.C. 20013, (202) 447-4531.

3. Snow Survey and Water Supply Forecasting. This program provides information on forthcoming water supplies which are derived primarily from snow melt. Water supply forecasts based on hydrometeorologic data collected are used in managing water resources. That information is available throughout most of western United States.

Contact: State or local Soil Conservation Service office in western states except California. In California, contact the Department of Water Resources or contact the Department of Agriculture, Soil Conservation Service, Box 2890, Washington, D.C. 20013 (202) 447-4531.

4. Inventory and Monitoring. Assistance is available for the collection, interpretation and publication of natural resource data in the form of resource inventories. Those inventories identify farmlands critical to the maintenance of the natural resource base and agricultural production. Assessments of nonpoint sources of pollution (erosion and sediment) for control planning are also made.

Contact: State or local Soil Conservation Service office or Department of Agriculture, Soil Conservation Service, Box 2890, Washington, D.C. 20013, (202) 447-4531.

Federal Level: Department of Defense

Department of the Army, Office of the Chief of Engineers

1. Flood Plain Management Services. This program provides information, technical services, and guidance necessary to promote appropriate recognition of flood hazards in land and water use planning and development. Flood plain and flood hazard information are used as a basis for planning flood plain land use, and in developing flood plain regulations.

Contact: Nearest U.S. Army District, Attention: FPMS or Department of Defense, Department of the Army, Office of the Chief of Engineers, Attention: DAEN-CWP-F, Washington, D.C. 20314, (202) 272-0169.

Federal Level: Department of the Interior

Heritage Conservation and Recreation Service

1. Outdoor Recreation — Technical Assistance. Services are available for the development of outdoor recreation. Demonstration of approaches, concepts, and techniques for the solution of recreation problems is made for the States, localities and private interests by the Service. Advice on recreation-related matters may also be provided when qualified staff are available.

Contact: Regional Office of Heritage Conservation and Recreation Service or Department of the Interior, Heritage Conservation and Recreation Service, Division of Implementation Assistance, Washington, D.C. 20243, (202) 343-6767 or (202) 343-7967.

U.S. Fish and Wildlife Service

1. Fishery Research — Information. Information needed for the protection and enhancement of freshwater fishery resources is developed and disseminated through this program. Such research-expanded knowledge of fishery biology

is used to improve management of public fishery resources, and to advance related private enterprises.

Contact: Department of the Interior, U.S. Fish and Wildlife Service, Washington, D.C. 20240, (202) 343-2279.

2. Environmental Contaminant Evaluation. This program seeks to disseminate information and to provide technical assistance concerning the effects of pesticides on fish and wildlife ecology. The effects and potential ramifications of chemical pollutants in selected ecosystems are assessed through field appraisals and monitoring.

Contact: Department of the Interior, U.S. Fish and Wildlife Service, Division of Ecological Services, Contaminant Operations, Washington, D.C. 20240, (202) 343-4034.

3. Sport Fish Technical Assistance. This program provides technical assistance and information useful for the management of waters for sport fishing. Biological and environmental assessments are available that make specific management recommendations. Stocking of fishes from National Fish Hatcheries may be one of the management tools considered.

Contact: Local office or Department of the Interior, U.S. Fish and Wildlife Service, Office of Fishery Assistance, Washington, D.C. 20240, (202) 632-5166.

4. Wildlife Technical Assistance. This program provides technical assistance and information for improved management of wildlife resources where demonstrated need for services exists. Requests may be made for dissemination of technical information and training by Federal agencies and Indian tribes. Personnel will also assist in teaching short courses.

Contact: Local office or Department of the Interior, U.S. Fish and Wildlife Service, Office of Wildlife Assistance, Washington, D.C. 20240, (202) 632-2202.

5. Wildlife Ecology Research Information. This program conducts research concerning wildlife resources and disseminates this information to provide for improved protection and enhancement of wildlife resources. Interested persons may request information on any aspect of the following research subjects: Environmental contaminant evaluation, migratory birds, mammals and nonmigratory birds, animal damage control, and endangered and threatened species.

Contact: Department of the Interior, U.S. Fish and Wildlife Service, Division of Wildlife Ecology Research, Washington, D.C. 20240, (202) 343-7557.

Geological Survey

1. Geologic and Mineral Resource Surveys and Mapping. The Geological Survey provides assistance in cooperative projects to prepare geologic maps throughout the United States.

Projects can also seek to appraise mineral and fuel resources and to carry out research in the field. Such work provides the physical basis for the effective planning of programs for development of natural resources and the efficient operation of interrelated projects at Federal, State and local levels.

Contact: Department of the Interior, Geological Survey, National Center, 12201 Sunrise Valley Drive, Mailstop 911, Reston, Virginia 22092, (703) 860-6531.

2. Cartographic Information. The Geological Survey provides users with information about maps, charts, geodetic control, aerial and space imagery, and related cartographic data generated by the Federal government and State, local and private sources. Orders are accepted and forwarded to participating data depositories.

Contact: Local office or Department of the Interior, Geological Survey, National Cartographic Information Center, National Center, 12201 Sunrise Valley Drive, Mailstop 507, Reston, Virginia 22092, (703) 860-6045.

3. Topographic Surveys and Mapping. The Geological Survey works in cooperative projects with the goal of mapping the Nation in accordance with an established national standard and to keep the maps up-to-date. Technical information and maps produced in such projects provide basic information for the development and management of natural resources and the efficient planning and operation of interrelated projects at the Federal, State and local levels.

Contact: Department of the Interior, Geological Survey, Topographic Division, National Center, 12201 Sunrise Valley Drive, Mailstop 516, Reston, Virginia 22092, (703) 860-6231.

4. Water Resources Investigations. Water information is available to provide for enhanced economic development and best use of water resources. Hydrology research is encouraged. Projects provide basis for effective management and development programs for natural resources and efficient operation of interrelated projects at the Federal, State and local levels.

Contact: Department of the Interior, Geological Survey, National Center, 12201 Sunrise Valley Drive, Mailstop 409, Reston, Virginia 22092, (703) 860-6921.

National Park Service

1. National Environmental Study Areas and National Environmental Education Development Programs. National Environmental Study Areas are available for use by schools and other interested groups for demonstrating natural, social or cultural principles. Use of property, facilities and equipment, advisory services and counseling, and dissemination of technical information are provided for.

Contact: Regional office or Department of the Interior, National Park Service, Division of Inter-

pretation and Visitor Services, National Environmental Study Areas and National Environmental Education Development Programs, Washington, D.C. 20240, (202) 523-5444.

2. Park Technical Assistance. Technical assistance is available for the planning, developing and managing of park and recreation areas. Agency management, operation and maintenance of park systems, historical and archeological programs, and general development planning are covered on a site-specific basis. Indian tribes, States and local units of government, private, nonprofit organizations, individuals and territories can apply for assistance.

Contact: Regional office or Service Center or Department of the Interior, National Park Service, Division of Federal and State Liaison, Washington, D.C. 20240, (202) 523-5190.

3. Park Practice Program. The National Park Service disseminates information concerning design, operation and maintenance of parks and recreation facilities, to park and recreation professionals and practitioners. Publications and program materials are used as a teaching and reference source.

Contact: Regional or local office or Department of the Interior, National Park Service, Division of Federal and State Liaison, Washington, D.C. 20240, (202) 523-5190.

4. Training Institute for Park and Recreation Management. Assistance is provided, on a cost-shared basis, for the preparation and presentation of training courses for park and recreation departments of State and local governments. Assistance in training needs assessment and facility development is also available.

Contact: Regional office or Department of the Interior, National Park Service, Division of Federal and State Liaison, NPS Training Institute, Washington, D.C. 20240, (202) 523-5190.

Federal Level: General Services Administration

1. National Archives Reference Services. A reference service is available to help the general public make use of records and historical materials of the Federal government. Information is furnished by the National Archives, six Presidential Libraries, and 15 Federal Records Centers.

Contact: Regional office or General Services Administration, National Archives and Records Service, Central Reference Division, Washington, D.C. 20408, (202) 523-3218.

2. National Audiovisual Center. The National Audiovisual Center serves as an information, sales, loan, and technical service center for audiovisual materials produced by or for Federal agencies.

Contact: General Services Administration, Na-

tional Audiovisual Center, Washington, D.C. 20409, (301) 763-1896.

3. *Federal Information Center.* The Federal Information Center provides a single center in each major metropolitan area for the public to seek information about Federal agencies. Technical information is disseminated or an accurate referral to the office which can best assist the citizen is made.

Contact: Local Federal Information Center or General Services Administration, Consumer Information Center, Washington, D.C. 20405, (202) 566-1794.

Federal Level: Government Printing Office

1. *Depository Libraries for Government Publications.* Libraries designated as depository libraries receive certain government publications. They serve as reference centers for government documents. The purpose of this program is to make government publications, including many which are out of print, available for reference in local areas.

Contact: Local Depository Library or Government Printing Office, Library and Statutory Distribution Service, 5236 Eisenhower Avenue, Alexandria, Virginia 22304, (703) 557-2050.

2. *Government Publications — Sales and Distribution.* Certain United States government publications are available for purchase through the Government Printing Office.

Contact: Regional or local office or Government Printing Office, Superintendent of Documents, Washington, D.C. 20402, (202) 275-3345.

Federal Level: Library of Congress

1. *Library of Congress Publications.* Guides to Library of Congress collections are available for purchase from the Government Printing Office. The purpose of this program is to provide Congress, government agencies, the research community, and the general public with information about the collections of the Library of Congress.

Contact: Library of Congress, Publishing Office, Washington, D.C. 20540, (202) 287-5093.

2. *Library of Congress Research Services.* Specialized reference and bibliographic services are available in such diverse fields as American history and science. Materials covered include manuscripts, maps, phonograph records, prints, photographs, and motion pictures. Certain guidance is offered in the identification and use of material, and limited reference service is offered in answer to written inquiries to correspondents.

Contact: Library of Congress, General Reading Rooms Division, Washington, D. C. 20540, (202) 287-5530.

3. *Reference and Referral Services in Science and Technology.* Reference specialists of the Science and Technology Division of the Library

of Congress will answer, without charge, brief technical inquiries entailing a bibliographic response. The Division also provides free referral service through its National Referral Center by directing those who have a question about a particular subject to organizations or individuals that can provide the answer.

Contact: Library of Congress, National Referral Center (referral services) or Science and Technology Division (reference services), Washington, D.C. 20540, (202) 287-5670 or (202) 287-5639.

Federal Level: Smithsonian Institution

1. *Smithsonian Science Information Exchange, Inc.* The Exchange serves as a clearinghouse for information about ongoing or recently terminated scientific research projects. Answers to a variety of questions may be compiled or assembled from an indexed register of projects supported by Federal and many nonfederal agencies. Such information is voluntarily contributed by those agencies. There is a charge made for the cost of retrieving and providing information from the file.

Contact: Smithsonian Institution, Smithsonian Science Information Exchange, Inc., Room 300, 1730 M Street N.W., Washington, D.C. 20036, (202) 381-4211.

Regional Level: Tennessee Valley Authority

1. *Tennessee Valley Region — Water Resources Development.* Services are available for developing and operating the Tennessee River system for navigation, flood control, and power. These services are limited to the Tennessee Valley region, and also include related benefits of industrial development, water quality management, recreation development, and fish and wildlife development for the social and economic benefit of the region and in the national interest.

Contact: Tennessee Valley Authority, Knoxville, Tennessee 37902, (615) 632-2101.

Federal Level: Environmental Protection Agency

Office of Water and Waste Management

1. *Water Pollution Control — Direct Training.* The Environmental Protection Agency provides technical courses and distributes materials for training of individuals and organizations concerned with water quality and water pollution. Courses are offered at the National Training and Operational Technology Center and at one regional facility. Packaged courses and training support material are developed for use by other educational and training organizations in selected water pollution control subjects.

Contact: Regional offices of the Environmental Protection Agency or Environmental Protection Agency, National Training and Operational Technology Center, Cincinnati, Ohio 45268.

2. *Water Quality Control Information System — Orientation/Training Seminars, Data and Monitoring Publications.* This program provides for training in the use of the computer storage and retrieval (STORET) system used by OWWM for handling water quality and management data. Publications showing types, trends and progress in pollution control and methods of water monitoring for official, technical, administrative, and public use are also provided.

Contact: Regional offices of the Office of Water and Waste Management, Environmental Protection Agency or Environmental Protection Agency, Office of Water and Waste Management, Monitoring and Data Support Division, Washington, D.C. 20460, (202) 426-7764.

3. *Drinking Water Supply — Technical Assistance.* Assistance is available to ensure that water supply systems serving the public meet minimum national standards for the protection of public health.

Contact: Regional offices of the Environmental Protection Agency or Environmental Protection Agency, Office of Water and Waste Management, Washington, D.C. 20460, (202) 472-4160.

4. *Solid Waste Management Technical Assistance and Information Services.* Assistance is available to help improve solid waste management and to develop acceptable disposal alternatives. Technical assistance, without charge, can be provided on solid waste management, resource recovery, and resource conservation to State and local governments.

Contact: Regional offices of the Environmental Protection Agency. For technical assistance — Environmental Protection Agency, Office of Solid Waste (WH-563), Washington, D.C. 20460, (202) 755-9125. For all other information — Environmental Protection Agency, Office of Solid Waste (WH-562), Washington, D.C. 20460, (202) 755-9160.

Federal Level: Federal Emergency Management Agency

Federal Disaster Assistance Administration

1. *Disaster Assistance.* Services and grants are available for alleviating suffering and hardship resulting from emergencies or major disasters declared by the President. Contributions are made available for suppression of natural disasters, and for post-disaster repairs to, restoration or replacement of public facilities and certain private nonprofit facilities. Associated cleanup activities, temporary shelter for displaced persons and social services are also provided for.

Contact: Federal Disaster Assistance Administration regional office or Federal Emergency Management Agency, Federal Disaster Assistance Administration, Washington, D.C. 20410, (202) 634-7825.

STATE/LOCAL PROGRAMS

State Level: Alabama

State Public Health Department

Water Improvement Commission

1. *314 Clean Lakes Program (Federal).* Alabama has not taken an active involvement in the 314 Clean Lakes Program up to the present time. The Water Improvement Commission is the designated agency for coordinating this program in the future.

Contact: Alabama State Public Health Department, Water Improvement Commission, State Office Building, Montgomery, Alabama 36130, (205) 277-3630.

State Level: Alaska

Department of Environmental Conservation

Water Quality Control Section

1. *314 Clean Lakes Program (Federal).* The Water Quality Control Section has responsibility for administering the Federal 314 Clean Lakes Program for Alaska although at the present time Alaska has not become involved with the program. They have participated in 208 Planning and have used some 208 funds for demonstration projects that have addressed nonpoint source water pollution control.

Contact: Alaska Department of Environmental Conservation, Water Quality Control Section, Pouch O, Juneau, Alaska 99801, (907) 465-2655.

Department of Natural Resources

1. *Outdoor Recreation, Open Space and Historic Preservation Development Fund.* The Department of Natural Resources provides grants for up to 25% of the project costs to local government units for the development and maintenance of park and recreational facilities. These funds were specifically set up to match the Federal Land and Water Conservation Program which will pay 50% of park and recreational projects.

Contact: Alaska Department of Natural Resources.

State Level: Arizona

Department of Health Services

Bureau of Water Quality Control

1. *314 Clean Lakes Program (Federal).* The Department of Health Services administers the Federal 314 Clean Lakes Program. No State funding programs are available at the present time for matching moneys. It is anticipated that technical assistance from the department and other sources would be utilized as an in-kind match for future 314 Clean Lakes projects.

Contact: Arizona Department of Health Services, Bureau of Water Quality Control, 1740 West Adam Street, Phoenix, Arizona 85007, (602) 255-1252.

Arizona Outdoor Recreation Coordinating Commission

1. *State Lake Improvement Fund.* This state program provides grants for up to 100% of project costs to municipal, county, or State governmental units for boating-related projects. Costs of land acquisition are not covered. The Outdoor Recreation Coordinating Commission is interested in coordinating this program with 314 Clean Lakes restoration projects.

Contact: Arizona Outdoor Recreation Coordinating Commission.

State Level: Arkansas

Department of Pollution Control and Ecology

1. *314 Clean Lakes Program (Federal).* The Department of Pollution Control and Ecology is the agency designated to administer the Federal 314 Clean Lakes Program. Advisory services are available in the application process, but matching moneys must be provided locally.

Contact: Arkansas Department of Pollution Control and Ecology, 8001 National Drive, P. O. Box 9583, Little Rock, Arkansas 72219, (501) 371-1701.

Department of Local Services

1. *Local Government Water, Sewer and Solid Waste Management Systems Revolving Fund.* This fund provides loan and grant assistance to communities with special needs due to large numbers of persons with low income, elderly or unemployed or a combination of these. The funds are used to match Federal grants or to supplement Federal loans for the development of water, sewer, and solid waste management systems. The State may provide grants of up to 25% of project costs to match water and sewer grants such as the Federal 201 Sewage Construction Grants Program and up to 50% of project costs in the form of loans for solid waste programs. The recipient must be a public unit of government (city, town or county) or a special public entity such as an improvement district or water association providing water, sewer or solid waste services. Other funding sources must be exhausted first.

Applications are submitted concurrently to the Department of Local Services and the appropriate Regional Planning and Development District and Regional Planning Commission. Applications are also reviewed by the Department of Pollution Control and Ecology and the Department of Health.

Contact: Arkansas Department of Local Services, Number One, Capitol Mall, Little Rock, Arkansas 72201, (501) 371-1211.

Soil and Water Conservation Commission

1. *Arkansas Water Development Fund.* This fund has provided grants primarily for water

supply projects. However, the Act authorizing the formation of this program includes projects related to flood control, irrigation, drainage, navigation, recreation, and fish and wildlife as well. It has been used to match Farmer's Home Administration (FmHA) programs and could be a possible match for the EPA's 314 Clean Lakes Program if a project was considered to be of high enough priority. Recipients must be State, local or special purpose governmental units. While there is no specified limit to project cost that will be funded, most grants have ranged from 15-20% of total project costs.

Applications should be in by June 30. Allow 6-9 months lead time. If not funded in the year of application, applications will automatically be carried forward for consideration in the following year.

Contact: Arkansas Soil and Water Conservation Commission, Department of Commerce, 1818 West Capitol, Building A, Little Rock, Arkansas 72201, (501) 371-1611.

Game and Fish Commission

1. *Matching Federal Funds.* The Game and Fish Commission has been empowered by the Arkansas Legislature to spend moneys as needed to match Federal grants under the Pittman-Robertson Act or similar acts for the propagation, conservation and restoration of game and fish. This program may provide a potential source of funds to partially match the 314 Clean Lakes Program if these actions are included.

Contact: Arkansas Game and Fish Commission, Game and Fish Commission Building, No. 2 Natural Resources Drive, Little Rock, Arkansas 72205, (501) 371-1025.

State Level: California

Water Resources Control Board

1. *314 Clean Lakes Program (Federal).* The Division of Planning and Research under the Water Resources Board is the agency designated to coordinate the Federal 314 Clean Lakes Program in California. At the present time they are able to provide some technical assistance and advisory services in the processing of applications but local sponsoring governmental units must provide the matching moneys. Nine regional water quality control boards play an active role in reviewing proposals for projects and providing technical assistance to sponsors in their area.

Contact: California Water Resources Control Board, Planning and Research Division, P. O. Box 100, Sacramento, California 95801, (916) 445-7765.

2. *Clean Water and Water Conservation Bond Law of 1978.* The Water Resources Control Board provides grants and a few loans to municipalities for projects involving water conservation and wastewater reclamation. \$325,000,000 has been set aside to provide 12½% of the cost of

sewage treatment facility construction projects receiving Federal aid under the 201 Program. \$50,000,000 has been authorized for projects ineligible for Federal aid under the 201 Program. Guidelines are being developed for these funds, but it is anticipated that the State will provide a minimum of 50% of the shared cost. These funds provide a potential match for a 314 Clean Lakes project involving nonpoint source watershed control. They have been used to provide State matching moneys for the Federal 208 Planning Program.

Contact: California Water Resources Control Board, P. O. Box 100, Sacramento, California 95801, (916) 445-7765.

3. State Water Control Fund.

a. *Pollution Cleanup and Abatement Account.* This account provides funds for emergency cleanup of oil spills and other pollution accidents or incidents requiring immediate action. The State contracts the work to be done from the State operation account portion of the State Water Control Fund.

b. *Sites Closure and Maintenance Revolving Account.* This account is used by the State to close hazardous waste sites or other hazardous or polluted areas that have been abandoned until a responsible party can be located and action taken to have that party clean up or abate the pollution problem.

Contact: California Water Resources Control Board, P. O. Box 100, Sacramento, California 95801, (916) 445-7765.

Department of Water Resources and California Reclamation Board

1. *State Aid Program: Federal Flood Control Projects.* The Department of Water Resources in conjunction with the California Reclamation Board provides grants and loans to local governmental units for projects involving flood control and flowage. Emphasis has been on land acquisition, easements and rights-of-way. The State will provide up to 75% of land costs and 90% of other costs unless Federal funding is involved; for federally-funded projects the local share is unaffected but the State share will be diminished to be equal to the Federal share provided. About 10% of construction funds recently have been used to acquire easements for environmental impact reasons or to protect the environment for fish and wildlife enhancement. This program has been used extensively for U.S. Corps of Engineers' projects.

Contact: In the Central Valley — California Reclamation Board, Room 335, 1416 — 9th Street, Sacramento, California 95814; Outside the Central Valley — the California Department of Water Resources, Box 388, 1416 — 9th Street, Sacramento, California 95814.

Pollution Control Financing Authority

1. *Pollution Control Financing Authority Loan Program.* The Pollution Control Financing Authority provides loans to individuals and profit organizations for the construction of solid or liquid waste disposal facilities including resource recovery systems. The Pollution Control Finance Authority also finances the construction of such facilities and then leases them back to the applicant. The need to comply with air and water quality standards is the main criterion for eligibility. Pollution abatement facilities must not improve productivity; by-products must be a means of waste disposal rather than being profitable to the operation. This program may be used in conjunction with applicable Federal programs.

Contact: California Pollution Control Financing Authority, 915 Capitol Mall, Room 110, Sacramento, California 95814, (916) 445-9597.

Wildlife Conservation Board

1. *Recreation and Fish and Wildlife Enhancement Bond Act.* Continual bonding issuances authorized by the California Legislature and voters have provided funding for the planning and development of facilities for recreation and fish and wildlife enhancement in connection with State and local water projects. Some of these funds are administered by the Wildlife Conservation Board largely for state water projects but they have cooperated with local communities as well.

Contact: California Wildlife Conservation Board.

Department of Parks and Recreation

Office of Recreation and Local Services

1. *State Beach, Park, Recreational and Historical Facilities Bond Act of 1974. Nejedly-Hart State, Urban, and Coastal Park Bond Act of 1976.* These Bond Acts of 1974 and 1976 provided for assistance to local communities for park and recreational facility development including the costs of land acquisition. \$90,000,000 was authorized in 1974 and \$86,000,000 in 1976 and was allocated to governmental agencies on a block grant basis. Most of these funds have been committed. Projects are limited to outdoor facilities. A 1980 Bond Act is now before the legislature to provide \$95,000,000 to replace the Bond Acts of 1974 and 1976. The same guidelines will apply.

Contact: California Department of Parks and Recreation, Office of Recreation and Local Services, (916) 445-4441.

2. *Roberti-Z'berg Urban Open Space and Recreation Program.* This program, administered by the Department of Parks and Recreation, provides block grants to urbanized jurisdictions and a competitive grant program to both urban and nonurban communities for park and recreational facility development including land acquisition.

\$80,000,000 has been authorized to date for these purposes (\$10,000,000 for FY 80). Funds may be used for both indoor and outdoor facilities. The 1980 Bond Act now before the California Legislature is requesting an additional \$35,000,000 to extend this program.

Contact: California Department of Parks and Recreation, Office of Recreation and Local Services, (916) 445-4441.

State Level: Colorado

Department of Health

Water Quality Control Division

1. *314 Clean Lakes Program (Federal)*. The Water Quality Control Division is the agency designated to coordinate the Federal 314 Clean Lakes Program for Colorado. At the present time, Colorado has one 314 grant to classify the State freshwater lakes according to eutrophic condition, has applied for several project grants and has received an Urban Lakes Grant under the 314 Program. The matching funding for projects will come from either local sources or an in-kind service match using the technical assistance available in the Department of Health.

Contact: Colorado Department of Health, Water Quality Control Division, 4210 East 11th Avenue, Denver, Colorado 80220, (303) 320-8333.

Soil Conservation Board

The Soil Conservation Board is the State coordinating board for the local Soil Conservancy Districts. These local districts are active in wetland management, 208 Planning, and in administering Federal grant-in-aid programs for the Department of Agriculture.

Contact: Local Soil and Water Conservation District.

State Level: Connecticut

Department of Environmental Protection

1. *Lakes Management Program*. This is a new program, proposed in February, 1980 to the Connecticut State Legislature, to provide grants and/or technical assistance to State and local government units for comprehensive measures directed toward improving lake water quality. \$150,000 has been requested for FY 80 which will provide seed money for the program with financial commitments increasing as more lakes are brought into the program and as actions are taken to implement preservation and restoration measures. This program has been designed to match Federal 314 Clean Lakes Funds.

Contact: Connecticut Department of Environmental Protection, Water Compliance, State Office Building, Hartford, Connecticut 06115, (203) 566-7049.

2. *Weed and Algae Control Program*. This program reimburses local governmental units or established lake authorities for up to 100% of annual costs of chemical treatment of algae and

aquatic vegetation, harvesting and minor physical measures to control weed and algae growth.

A notice is sent annually to chief elected town officials regarding the program. Requests for reimbursement must be received by December 1 and be accompanied by an itemized voucher and appropriate permits of chemical treatment if used. When total requests exceed the total program authorization, reimbursements are prorated.

Contact: Connecticut Department of Environmental Protection, Water Compliance, State Office Building, Hartford, Connecticut 06115.

3. *Wildlife Refuges, Fish Spawning Areas and Refuges*. The Department of Environmental Protection not only administers Federal programs related to fish and wildlife enhancement on State lands and refuges, but can provide technical assistance to local communities for these purposes as well.

Contact: Connecticut Department of Environmental Protection, Wildlife Management, State Office Building, Hartford, Connecticut 06115, (203) 566-2287.

State Level: Delaware

Department of Natural Resources and Environmental Control

Fish and Wildlife Division

1. *314 Clean Lakes Program (Federal)*. The Fish and Wildlife Division of the Department of Natural Resources and Environmental Control has been designated as the agency to coordinate the Federal 314 Clean Lakes Program. They have contracted with the University of Georgia to undertake a classification study and prioritization of 30 public lakes according to eutrophic condition. No financial assistance is presently available as an ongoing program; local sponsors provide matching monies; State sponsored projects require special appropriation of moneys.

Contact: Delaware Department of Natural Resources and Environmental Control, Fish and Wildlife Division, P. O. Box 1401, Dover, Delaware 19901, (302) 678-4431.

State Level: Florida

State Department of Environmental Regulation

Division of Environmental Programs: Bureau of Water Management

The Bureau provides technical assistance and information based on 208 planning and assessment studies. It also sets standards and adopts regulations for water quality maintenance and coordinates volunteer programs that might provide a potential in-kind match for the 314 Clean Lakes Program. In addition, the Bureau administers the Water Resources Restoration and Preservation Program.

1. *Water Resources Restoration and Preservation Program.* The Bureau of Water Management makes contracts for both Phase 1 feasibility and Phase 2 implementation projects involving watershed and in-lake control, engineering design, and development of lake/lakeshore usage using funds from general revenues, a Pollution Recovery Fund and available Federal moneys owed from the 314 Clean Lakes Program. Moneys may not be used for 1) construction of treatment facilities for domestic or industrial waste disposal or 2) restoration or preservation of a water resource if point sources affecting it will not be in compliance with applicable standards or pollution from nonpoint sources is not controlled or 3) temporary, palliative or cosmetic treatments unless such treatments are part of a long-term solution. Local, State and special purpose governmental units are eligible sponsors of projects. The State will fund up to 60% of feasibility studies and 80% of the nonfederally funded part of implementation projects. Contracts for projects of unusually high scientific value and exceptional difficulty for successful restoration may be funded up to 100%; however, only two such projects are allowed per year.

Feasibility study applications are accepted at any time and are awarded depending on available moneys. Implementation project applications must be received by September 1 for funding in the following fiscal year; awards are dependent on the problem priority and the project's potential value as a solution, as well as available moneys. Consideration is given to equitable geographic distribution of projects.

Contact: Florida Department of Environmental Regulation, Division of Environmental Programs, Bureau of Water Management, 2600 Blair Stone Road, Twin Towers Office Building, Tallahassee, Florida 32301, (904) 488-9560.

Division of Environmental Programs: Bureau of Drinking Water and Solid Waste Management

This Bureau processes the sewage treatment construction grants program (Florida does not provide any matching grant funds), issues permits and enforces water quality standards, and provides technical assistance to local communities. In addition, this Bureau handles the Bond Program.

1. *Pollution Control Measures and Devices (Bond Program).* This program provides loans at low interest rates for financing pollution control devices to local governmental units.

Contact: Florida State Department of Environmental Regulation, Division of Environmental Programs, Bureau of Drinking Water and Solid Waste Management, 2600 Blair Stone Road, Twin Towers Office Building, Tallahassee, Florida 32301, (904) 488-9560.

Department of Natural Resources Division of Parks and Recreation

1. *Florida Recreation Development Assistance Program.* This is a grant program to local governmental units for park and recreational development. The State will pay 100% of project costs on the first \$50,000 and 50% of the next \$200,000 for an overall State limit of \$150,000. Projects cannot exceed \$250,000 in total costs.

Contact: Florida Department of Natural Resources, Division of Parks and Recreation, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303, (904) 488-6322.

2. *Florida Boating Improvement Fund.* This fund provides grant assistance for the development of boating facilities to local governmental units. Moneys are generated from a portion of boat registration fees in each county.

Contact: Florida Department of Natural Resources, Division of Parks and Recreation, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303, (904) 488-6322.

State Level: Georgia

Department of Natural Resources Environmental Protection Division: Water Quality Section

1. *314 Clean Lakes Program (Federal).* The Water Quality Section of the Environmental Protection Division is presently involved in the classification and prioritization of lakes according to eutrophic condition. They are able to provide technical assistance as well as advisory services in the processing of 314 Clean Lakes project applications, but matching moneys will have to be provided at the local level. Phase 1 cooperative agreements (diagnostic-feasibility studies) are funded 70% Federal and 30% nonfederal; Phase 2 (implementation) 50/50.

Contact: Georgia Department of Natural Resources, Environmental Protection Division, Water Quality Section, 270 Washington Street S.W., Room 822, Atlanta, Georgia 30334.

2. *Economic and Environmental Grant Program.* The Water Quality Section of the Environmental Protection Division provides grants to local governmental units for water supply and water pollution control projects including sewage treatment facility construction. Applicants must provide a 50% nonstate dollar match. Federal EPA funds are not eligible as a nonstate match. \$5,000,000 has been authorized for use in FY 80 to fund at least eight projects. The emphasis is on aiding facility construction where major community impact has created the need for new facilities to accommodate new or expanded industrial, governmental or commercial enterprises.

Contact: Georgia Department of Natural Resources, Environmental Protection Division, Water Quality Section, 270 Washington Street S.W., Atlanta, Georgia 30334.

3. *Emergency Grant Program.* The Water Quality Section administers an emergency grant program for sewage treatment or water supply facility construction. \$1,000,000 has been authorized for use in emergency situations where an existing facility has failed. State aid may be up to 100% for the first \$25,000 in costs and up to 50% of costs in excess of \$25,000.

Contact: Georgia Department of Natural Resources, Environmental Protection Division, Water Quality Section, 270 Washington Street S.W., Atlanta, Georgia 30334.

Division of Parks and Recreation and Historic Sites

1. *Georgia Heritage Trust Program.* The Georgia Heritage Trust Fund was established to identify, protect and preserve cultural, natural and recreational areas throughout the State. A fourth of the State moneys appropriated each year for this program are used to provide grants to local governmental bodies for the preservation of historic, natural and passive recreational sites. The remaining funds are allotted for State acquisition. Grants to local governments for natural area preservation use a matching formula of 30% local, 20% State and 50% Federal Land and Water Conservation Funds. For passive recreational projects, the cost share formula is 40% local, 10% State, and 50% Federal. Historic preservation is cost shared 50/50 by the State and local sponsor.

Contact: Georgia Department of Natural Resources, Division of Parks and Recreation and Historic Sites, Heritage Trust Program, 270 Washington Street S.W. 815-0, Atlanta, Georgia 30334.

State Level: Idaho

Department of Health and Welfare

1. *314 Clean Lakes Program (Federal).* The Department of Health and Welfare is the agency designated to process applications for the 314 Clean Lakes Program. At the present time, however, the Department is able to provide only water quality monitoring and laboratory support to governmental bodies and nonprofit organizations for nonpoint source water pollution control.

Contact: Idaho Department of Health and Welfare, Division of Environment, Statehouse, Boise, Idaho 83720, (208) 334-4250.

Department of Water Resources

1. *Water Resources Loans and Grants Program (Revolving Development Fund and Water Management Account).* This program has largely been concerned with water reclamation projects deemed to be in the public interest. It provides grants of up to \$50,000 and loans up to \$500,000 to eligible recipients (irrigation districts, municipalities, private corporations, and, in special cases, individuals). The enacting legislation,

however, is broad enough to include studies of lake pollution and the regulation or control of stream flow for aquatic life, and to minimize pollution and protect recreational use of waters.

Contact: Idaho Department of Water Resources, Statehouse, Boise, Idaho 83720.

Department of Parks and Recreation

1. *Idaho Waterways Improvement Fund.* The Waterways Improvement Fund Act of 1965 established a fund to provide 100% grants to protect and promote safety and waterway improvement. Eligible activities include creation and improvement of boat ramps and moorings, marking of waterways, and the purchase of real and personal property. Average project grants are \$10,000. \$300,000 has been authorized for FY 80.

Applications are accepted in April and November by the Department of Parks and Recreation local County Waterways Committees.

Contact: Chairman of the appropriate local County Waterways Committee (name may be obtained from local County Commissioners).

2. *Technical Assistance.* The Public Service Bureau of the State Recreation Division provides technical assistance to political subdivisions and others involved in making recreational opportunities available to the public. Assistance with planning, park and facility design, application for grants-in-aid assistance, information on the formation of recreational districts, technical information on operation and maintenance and access to the Division's professional library is available.

Contact: Idaho Department of Parks and Recreation, Statehouse, Boise, Idaho 83720, (208) 384-2284.

State Level: Illinois

Environmental Protection Agency

Division of Water Pollution Control

1. *Lakes Program, Planning Section.* The Lakes Program, Planning Section, of the Division of Water Pollution Control has been involved in the lake evaluation process under the 208 Water Quality Management Planning Program and is the designated agency to process 314 Clean Lakes Program proposals. In 1980-81, a lake survey, classification and restoration priority ranking of up to 250 publicly-owned lakes will be carried out. This information will be made available for public use in the development of funding requests and lake/watershed management plans. At the present time, however, no financial assistance is available to provide matching moneys for the 314 Clean Lakes Program.

Contact: Illinois Environmental Protection Agency, Division of Water Pollution Control, Lakes Program, Planning Section, 2200 Churchill Road, Springfield, Illinois 62706, (217) 782-3362.

Department of Transportation

Division of Water Resources

The Division of Water Resources in the Department of Transportation has been active in projects related to flood control. They can provide technical assistance and advisory services but require special legislative authorization to finance projects. Past projects have included the planning, construction and maintenance of water resource improvements and facilities in connection with the development of the Kaskaskia River Watershed, coordination with the U.S. Army Corps of Engineers in constructing flood control improvements in the Blue Waters Dike Drainage Basin, and the development of recreational areas in conjunction with creation of a multipurpose reservoir on Big Kinkaid Creek.

Contact: Illinois Department of Transportation, Division of Water Resources, Bureau of Local Assistance, 2300 South Dirksen Parkway, Springfield, Illinois 62764, (217) 782-2152.

State Level: Indiana

State Board of Health

Stream Pollution Control Board

1. *314 Clean Lakes Program (Federal)*. The Stream Pollution Control Board is the designated agency to process applications for the Federal 314 Clean Lakes Program. Matching funding must be provided locally. Emphasis in the past has been placed on pollution prevention through extensive classification work, the development of lake management plans, and the use of regulations (for example, the Phosphorus Control Law, waste disposal systems regulations, etc.) to prevent the pollution of the State's lakes. Some in-kind services from University sources have been used to match Phase 1 diagnostic studies.

Contact: Indiana State Board of Health, Stream Pollution Control Board, 1330 West Michigan Street, Indianapolis, Indiana 46206, (317) 633-0100.

State Level: Iowa

Department of Environmental Quality

1. *314 Clean Lakes Program (Federal)*. The Iowa Department of Environmental Quality develops comprehensive plans and programs for prevention, control and abatement of water pollution and aids in the establishment of standards, objectives or criteria for water quality. This agency has responsibility for the 314 Clean Lakes Classification and Prioritization Study but does not have financial assistance available for matching Federal moneys. The lake classification study has been contracted to the State Conservation Commission and Iowa State University. The Statewide Water Quality Management Plan has been completed and approved by EPA and Clean Lakes Program activities have been identified in

the five-year strategy of the Plan. The governor will be designating the agency to coordinate the Clean Lakes Program in the future.

Contact: Iowa Department of Environmental Quality, Henry Wallace Building, Des Moines, Iowa 50319, (515) 281-8949.

State Conservation Commission

The State Conservation Commission has been active in the classification and prioritization of Iowa lakes and in lake restoration projects involving Federal 314 Clean Lakes funding. The State financial share of these project costs has come from general legislative appropriations and marine fuel taxes. No ongoing program exists, however, to provide grants for these purposes, and it is unlikely that lake restoration work will be undertaken extensively in the future except as contracted out by the Department of Environmental Quality. Technical expertise in this area might be of considerable value, however, to future 314 applicants.

1. *Boating Fund*. The State provides some grant aid for the development of boating facilities from funds received from marine fuel taxes. Eligibility of recipients and project cost restrictions are flexible.

Contact: Iowa State Conservation Commission, Waters Section, Henry Wallace Building, Des Moines, Iowa 50319, (515) 281-3449.

Department of Soil Conservation

1. *State Cost Share Fund*. The Department of Soil Conservation allocates funds to 100 Soil Conservation Districts for cost sharing with landowners who construct permanent soil conservation practices. Usual cost share rate is 50%. Landowners may receive 75% cost share assistance for work done in the watersheds of designated State-owned lakes. Funding level is \$5,000,000 each year for FY 79-80 and FY 80-81. Moneys for 75% cost sharing for State-owned lakes may not exceed 5% of the appropriation. The Department has four years to expend the funds. In addition to permanent practices, the Department may allow up to 10% of each appropriation to be used for incentive payments for conservation tillage.

Contact: Iowa Department of Soil Conservation, Henry Wallace Building, Des Moines, Iowa 50319.

State Level: Kansas

Department of Health and Environment

1. *314 Clean Lakes Program (Federal)*. The Kansas Department of Health and Environment administers the Federal 314 Clean Lakes Program. No state financial assistance is available at the present time to match the Federal moneys; this must be provided locally. Some nonpoint source planning and inventory of lakes is under-

way utilizing Department of Health and Environment staff.

Contact: Kansas Department of Health and Environment, Forbes Field, Topeka, Kansas 66620, (913) 862-9360.

Fish and Game Commission

1. *Community Lake Assistance Project (CLAP)*. Utilizing moneys from fishing licenses and fees, this project enables the Fisheries Division to provide technical assistance and fish for stocking of lakes to local, State, and special purpose governmental units. Moneys are also used to match the Federal Dingel/Johnson Program; the State providing 25% and the Federal government 75% of project costs.

Contact: Kansas Fish and Game Commission, Rural Route 2, Box 54A, Pratt, Kansas 67124, (316) 672-5911.

Water Resources Board

The Water Resources Board has been concerned primarily with water quantity, especially water storage. They could become involved in wetland management where water flow control is important, for example, in a flood control project. They have coordinated in the past with the Department of Health and Environment on planning and policy development.

1. *State Financial Assistance to Certain Public Corporations or Water Development Projects*. This program can provide reimbursement of part of the costs for lands, easements and rights-of-way incurred on a flood control project where at least 20% of the benefits derived go beyond the boundaries of such public corporation, the project is consistent with the area water plan, the public corporation is deemed needy of such financial assistance for expenditures within the fiscal year following, and where funds have been appropriated by the legislature for such purposes.

Contact: Kansas Water Resources Board, 503 Kansas Avenue, Topeka, Kansas 66603, (913) 296-3185.

State Level: Kentucky

Department of Natural Resources and Environmental Protection

Division of Water Quality

1. *314 Clean Lakes Program (Federal)*. The Division of Water Quality in the Department of Natural Resources and Environmental Protection is the agency designated to coordinate the Federal Clean Lakes Program. They are able to provide limited technical assistance and advisory services to local communities in the application process. No state funding is available.

Contact: Kentucky Department of Natural Resources and Environmental Protection, Division of Water Quality, 1065 U.S. 127 Bypass South, Century Plaza, Frankfort, Kentucky 40601, (502) 564-7885.

Division of Water Resources

1. *Community Flood Damage Abatement Program*. Through this program, the Division of Water Resources may provide grants to local governmental units for flood prevention measures and flood damage restoration measures. Engineering design and construction projects that would be of use in watershed control are eligible. Approximately \$7,500,000 per year has been allocated. Some funds are provided by local communities to match the State funds; however, the amount is flexible depending on the extent of damage and ability of the community to pay. These moneys have been used to match some of the Federal Soil Conservation Service programs administered by the Department of Agriculture.

Contact: Local Development District Office or the Kentucky Department of Natural Resources and Environmental Protection, Division of Water Resources, Old Wilkenson Street School, Wilkenson Boulevard, Frankfort, Kentucky 40601, (502) 564-3980.

Area Development Districts

1. *Area Development Fund*. The State provides moneys by appropriation to regional planning agencies (Area Development Districts) for use as grants-in-aid and provides technical assistance to local governmental units for projects pertaining to recreational and park facility development. These moneys have been used in the past to help provide matching funds for the Federal Land and Water Conservation Funds.

Contact: Local Area Development District Office.

County Judges

1. *Economic Aid (formerly: Coal Severance Monies)*. The county judges in Kentucky allocate revenues from coal taxes as grants to local government units for the development of recreation and park facilities. These moneys have been used to match the Federal Land and Water Conservation Funds administered by the Department of Parks.

Contact: Local County Judge's Office.

State Level: Louisiana

Department of Natural Resources

Division of Water Pollution Control

1. *314 Clean Lakes Program (Federal)*. The Division of Water Pollution Control in the Louisiana Department of Natural Resources is the designated agency to apply for and accept 314 Clean Lakes Grants. There are no State funds or programs set up to match these grants at the present time. A lake classification study was carried out by the Department of Wildlife and Fisheries prior to the shifting of responsibility for the Clean Lakes Program to the Department of Natural Resources.

Contact: Louisiana Department of Natural Resources, Office of Environmental Affairs, Divi-

sion of Water Pollution Control, P. O. Box 44066, Capitol Station, Baton Rouge, Louisiana 70804, (504) 342-6372.

State Level: Maine

Department of Environmental Protection

Division of Lakes and Biological Studies

1. *314 Clean Lakes Program (Federal)*. The Division of Lakes and Biological Studies primarily has the responsibility of lake monitoring for the State of Maine. A classification priority system has been developed whereby the public lakes have been studied, classified according to eutrophic condition and twenty lakes have been identified as needing work to restore their quality. This agency accepts and submits applications for the 314 Clean Lakes Program. Thus far, matching moneys have come from local sources including in-kind match of technical assistance by this agency and the Soil Conservation Service.

Contact: Maine Department of Environmental Protection, Division of Lakes and Biological Studies, State House, Augusta, Maine 04333, (207) 289-2811.

Department of Conservation

Land Use Regulation Commission

The Land Use Regulation Commission has regulatory control over lakes in the unorganized portions of the State. They provide no funding program but do have their own lakes program which they run in coordination with the Department of Environmental Protection. This program is primarily implemented by land use controls supplemental with land use education efforts.

Contact: Maine Department of Conservation, Land Use Regulation Commission, State House, Station #22, Augusta, Maine 04333.

Bureau of Parks and Recreation

1. *Municipal Recreation Fund*. The Bureau of Parks and Recreation provides small grants (maximum project cost of \$5,000) to local governmental units for projects and programs concerned with park and recreational development. The State cost shares with the local community 50/50 on projects. \$75,000 is available each year for this program.

Contact: Maine Department of Conservation, Bureau of Parks and Recreation, State Office Building, Mail Station 19, Augusta, Maine 04333.

2. *Land and Water Conservation Fund (Federal)*. The Bureau of Parks and Recreation administers the Federal Land and Water Conservation Program to local governmental units for park and recreational development. Local sponsoring units must provide the entire 50% match except in high priority projects involving boat facilities for which the State is able to contribute up to 25% of the project moneys. Check for application filing periods.

Contact: Maine Department of Conservation, Bureau of Parks and Recreation, State Office Building, Mail Station 19, Augusta, Maine 04333.

State Level: Maryland

Department of Natural Resources

Water Resources Administration

1. *Clean Lakes Program (Federal)*. No agency has been officially designated to administer 314 Clean Lakes applications and 314 Clean Lakes grants from the Environmental Protection Agency. The Water Resources Administration has been involved with 208 Planning and some of the 208 Regional Planning Commissions have applied for and received 314 Clean Lakes funding. At the present time, the local project sponsor is required to provide matching moneys.

Contact: Maryland Department of Natural Resources, Water Resources Administration, Tawes State Office Building, Annapolis, Maryland 21401, (301) 269-2224.

2. *Program Open Space*. The Department of Natural Resources provides financial assistance in the form of grants (formula allotment) to local governmental units for the development of park and recreational facilities. Half the moneys received by the local community may be used for land acquisition and half for recreational development. A 25% match is required of the local sponsor on the portion that applies to recreational development. No match is required on the portion for land acquisition.

Contact: Appropriate county office or Maryland Department of Natural Resources, Program Open Space, Tawes State Office Building, Annapolis, Maryland 21401.

State Department of Health

1. *Water, Ice and Sewerage Program*. This program provides grants to counties and municipalities for sewage and central source system development. Moneys are to be used to provide a matching funding for the Federal Sewage Construction Grants Program (projects must qualify for federal aid). The State will cost share 50% (the other 50% to be provided by the local sponsor) of the nonfederally funded portion of project costs on a 75% Federal grant and 75%/25% (state/ local) on a 85% Federal grant.

Contact: Maryland State Department of Health.

State Level: Massachusetts

Department of Environmental Quality Engineering

Division of Waterways

1. *Eutrophication and Nuisance Aquatic Vegetation Control Program*. This program involves a preapplication and final application process in order for a community to receive funds for con-

trolling a problem in their lake. Formerly a simple weed control program, this program now gives first priority to projects which seek to solve the eutrophication problem at its source. The complete span of restoration techniques are eligible for funding (about \$120,000 available statewide during FY 80). The usual applicant is a city or town through the board of selectmen, conservation commission, health department, etc. This program is expected to be transferred to the Division of Water Pollution Control in order to consolidate and coordinate all lake functions state-wide.

Contact: Massachusetts Department of Environmental Quality Engineering, Division of Waterways, Room 532, 100 Nashua Street, Boston, Massachusetts 02114, (617) 727-4797.

Division of Water Pollution Control (314 designated agency)

1. *Massachusetts Lakes Program.* This program embodies the State's own program. Activities include statewide lake classification studies, diagnostic-feasibility studies, water assistance research team surveys (WART strikes), 314 coordination and project application administration, limnological data publication, State project priority listing, lake association assistance, coordination of Federal-State-local lake rehabilitation efforts, and related activities. Legislation presently under review, if successful, would provide up to \$2,000,000 in State matching funds for 314 projects as well as provide a firm legislative mandate for administering a statewide lakes program.

Contact: Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control, P. O. Box 545, Westborough, Massachusetts 01581, (617) 366-9181.

2. *Accelerated Water Pollution Control Program (Ch. 21, Sect. 31).* This program provides grants to public entities representing several municipalities for regional sewage and water pollution abatement planning. Grants are not to exceed \$15,000 per public entity.

Contact: Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control, 110 Tremont Street, Boston, Massachusetts 02108.

3. *Research and Demonstration Projects and Facilities.* The Division of Water Pollution Control can provide technical assistance and grant aid for studies and demonstration projects involving innovative ways of treating sewage. Anyone with appropriate ideas, including consultants, universities, communities, etc., may apply. \$1,000,000 has been authorized for FY 80. In the past, this program provided some matching moneys for the 314 Clean Lakes Program before emphasis shifted to sewage treatment. It is unlikely that it will be used to match 314 funds in the future.

Contact: Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control, P. O. Box 545, Westborough, Massachusetts 01581.

208 Regional Planning Commissions

The 208 designated Regional Planning Commissions have been especially active in Massachusetts and have coordinated their efforts with the Department of Environmental Quality Engineering to provide information on priority lakes and to organize public meetings to involve the public in lake restoration plans and projects.

Contact: Local Planning Office or Department of Environmental Quality Engineering, 208 Planning Division, 100 Cambridge Street, Boston, Massachusetts 02108.

Executive Office of Environmental Affairs

Division of Conservation Service

1. *Self-Help Program.* The Division of Conservation Service provides grants to Municipal Conservation Commissions to cover up to 50% of the costs of land acquisition for passive recreational use. Filing deadline for applications is August 31 each year. Only land acquisition costs are eligible and only Municipal Conservation Commissions may apply.

Contact: Executive Office of Environmental Affairs, Division of Conservation Service, John Saltonstahl Building, 100 Cambridge Street, Boston, Massachusetts 02108.

2. *Urban Self-Help Program.* The Division of Conservation Service reimburses local Park and Recreation Commissions of municipalities with a population of greater than 35,000 for up to 80% of the costs of land acquisition for park and recreational facilities. Only land acquisition costs (including appraisals) are eligible for reimbursement. Applications should be in by August 31 each year.

Contact: Executive Office of Environmental Affairs, Division of Conservation Service, John Saltonstahl Building, 100 Cambridge Street, Boston, Massachusetts 02108.

Massachusetts Congress of Lake and Pond Associations, Inc.

The major activity of the Congress is to forward the cause of lakes and ponds on every front. Their constitution states the purposes as follows:

1. To perform all acts appropriate to a nonprofit, scientific, literary, and educational corporation dedicated to the promotion and development of environmental quality standards essential for satisfactory life styles and conditions in the natural community.
2. To preserve the aesthetic, recreational, and commercial values of lakes and lakeshore properties through the maintenance and improvement of such environmental fac-

tors as watershed ecology, water quality, lake water levels, shoreline woodland management, agricultural soils practices, recreational and residential building standards, and related influences, such as water and boating safety.

Barely one year old, the Congress is only just beginning to grow and continuously experiments in innovative ways to become effective for the cause of lakes and ponds. As their expertise increases the Congress should be able to contribute more and more to the State and Federal lake efforts in Massachusetts.

Contact: Massachusetts Congress of Lake and Pond Associations, Inc., P. O. Box 312, Westminister, Massachusetts 01473.

State Level: Michigan

Department of Natural Resources

Land Resource Programs Division

1. *314 Clean Lakes Program (Federal)*. The Department of Natural Resources is the agency designated to administer the 314 Clean Lakes Program. They are able to provide technical assistance to lake boards (special districts empowered to assess for and engage in activities related to lake improvement) concerning in-lake pollution control measures and engineering design. Such assistance may aid in providing an in-kind match for federally-funded 314 Clean Lakes projects.

Contact: Michigan Department of Natural Resources, Land Resource Programs Division, Inland Lake Management Unit, Steven T. Mason Building, Lansing, Michigan 48926, (517) 373-8000.

Recreation Service Division

1. *Urban Recreation Program*. The State will pay up to 100% of project costs on park and recreational development in the eleven SMSA's in Michigan. The State generally initiates projects and carries out the work, turning it over to the local community for operation and maintenance.

Contact: Michigan Department of Natural Resources, P. O. Box 30028, Mason Building, Lansing, Michigan 48909.

State Waterways Commission

The State Waterways Commission is active in acquiring sites for public access to lakes and has funding to construct and maintain facilities to enhance access, harbor and channel usage.

Contact: Michigan State Waterways Commission.

County Board of Supervisors

1. *Inland Lake Level Act*. The County Board of Supervisors, with the approval of the Department of Natural Resources, may initiate, plan, and execute projects to control lake levels. These projects are maintained by the county with the limitation that the County Drain Commission can

only spend up to \$1,500 without going to the board or holding special hearings.

Contact: Local County Board of Supervisors.

2. *Inland Lake Improvement Act*. The County Board of Supervisors can provide up to 25% of the cost of lake level stabilization projects on any public inland lake.

Contact: Local County Board of Supervisors.

State Level: Minnesota

Minnesota Pollution Control Agency (MPCA)

1. *Lake Improvement Grants-in-Aid*. The Minnesota State Legislature has provided moneys for lake improvement grants-in-aid. Local or regional units of government are eligible to apply for these grants. State funds are available on a matching basis for eligible projects in receipt of a Phase 1 or 2 Federal grant pursuant to USEPA's Clean Lakes Program (Section 314, Public Law 95-317). For the FY 80-81 biennium, \$60,000 has been allocated for Phase 1 grants and \$985,800 is available for Phase 2 grants. The Minnesota Pollution Control Agency administers both types of grants which are generally used to provide up to 50% of the required local funding under the Clean Lakes Program. Allow 1½ to 2 years lead time when applying.

Contact: Minnesota Pollution Control Agency, 1935 West County Road B2, Roseville, Minnesota 55113, (612) 296-7256.

Department of Natural Resources

The Department of Natural Resources will provide technical assistance in the areas of fish and wildlife habitat maintenance and development. They are also responsible for the maintenance, development, and operation of State parks.

Contact: Minnesota Department of Natural Resources, Centennial Office Building, St. Paul, Minnesota 55155.

State Soil and Water Conservation Board

In general, over 90% of the grants made by the State Soil and Water Conservation Board are made to private landowners or private or government groups. The State provides the guidelines for and checks the environmental impact of proposed projects. Most projects are completed within one to two years.

1. *Cost Share Program*. The State Soil and Water Conservation Board provides grants to private landowners for the provision of conservation measures. \$1,600,000 is authorized annually for these purposes. Priority is established by the State on the basis of geographic need and where moneys are distributed at the local level. Southern and southeastern Minnesota have been high priority areas in the past for this type of assistance.

Contact: Local Soil and Water Conservation Office.

2. *Lakeshore, Streambank, and Roadside Ero-*

sion Program. State grants are available for up to 50% of project costs on nonfederally-funded projects or up to 50% of the nonfederally funded portion of projects qualifying for Federal aid. Project emphasis is on the control of soil erosion along streambanks, lakeshores, and roadsides. Northern Minnesota has been a high priority area for this program.

Contact: Local Soil and Water Conservation Office.

3. Flood Control Program. The Soil and Water Conservation Board, working with 10 counties in southwestern Minnesota, has \$152,000 to spend annually on flood control facilities and for flood control purposes having widespread public benefit.

Contact: Local Soil and Water Conservation Office.

State Planning Agency

1. Legislative Commission on Minnesota Resources Fund. The State Planning Agency administers this program to provide matching grants for the Federal Land and Water Conservation Funds. The State will provide grants to cover up to 25% of project costs with the exception that building construction may be funded at only a 12½% level. \$2,633,158 has been authorized in FY 80 for use at the local level. A community recreation plan that includes reference to the park project under consideration must be on file. Preapplication deadline is May 2; final application deadline is October 3.

Contact: Minnesota State Planning Agency, Parks and Recreation Grants Section, Office of Local and Urban Affairs, Room 200, Capitol Square Building, 550 Wabasha, St. Paul, Minnesota 55101.

2. SMSAs Regional Program. This program provides grants to local, municipal or county government units for the development of parks of 100 acres or more that have some natural amenity likely to attract people from a regional area. The State will fund up to 50% of project cost.

Contact: Minnesota State Planning Agency, Parks and Recreation Grants Section, Office of Local and Urban Affairs, Room 200, Capitol Square Building, 550 Wabasha, St. Paul, Minnesota 55101.

Metropolitan Council

1. Parks and Open Space Program. The Parks and Open Space Commission provides both technical and financial assistance in the form of grants to local governmental units or lake associations (public or private) for projects involving park and recreational development and/or planning. It is possible that a project involving lake or wetland restoration or management might qualify for assistance, but the emphasis has been on park and recreational use in the past. These funds have been used to match 314 Clean Lakes Grants.

Contact: Metropolitan Council, Parks and Open Space Commission, 300 Metro Square Building, 7th and Robert Streets, St. Paul, Minnesota 55101.

Watershed Districts

The Watershed Districts have provided a limited source of funding on small lakes restoration projects of their own, using primarily tax monies.

County

1. Hennepin County Lake Improvement Funds. Hennepin County has established a lake improvement fund that has been utilized on lake restoration projects. Moneys could provide a match for a 314 Clean Lakes Grant.

Contact: Hennepin County Environment and Energy Department.

State Level: Mississippi

Department of Natural Resources

Bureau of Air and Water Pollution Control

1. 314 Clean Lakes Program (Federal). The Water Quality Management Section of the Department of Natural Resources is the agency designated to coordinate the Federal 314 Clean Lakes Program in Mississippi. Personnel in this Section are presently involved in a classification study. They are able to provide advisory services and/or administrative assistance in the project application and development process, but matching funding must be supplied at the local level.

Contact: Mississippi Department of Natural Resources, Bureau of Air and Water Pollution Control, Water Quality Management Section, P. O. Box 10385, Jackson, Mississippi 39209, (601) 354-2550.

State Level: Missouri

Department of Natural Resources (DNR)

Division of Environmental Quality (DEQ)

1. Water Pollution Control Program. The Division of Environmental Quality has responsibility for administering the Federal 314 Clean Lakes Program in Missouri. At the present time, they have undertaken a statewide lake classification survey. No funding policies have been developed by the State; however, planning and potential funding sources are being addressed. Local funding is required on current projects. In order to coordinate the efforts of other State and Federal agencies that are concerned with Missouri Clean Lakes Program, a Lake Restoration Advisory Committee has been organized. The Committee is composed of ten members with one representative from: the Missouri Department of Conservation; the University of Missouri-Columbia; Missouri Office of Administration; the USDA, Agricultural Stabilization Conservation Service and Soil Conservation Service; the

Missouri DNR, Division of Parks and Historic Preservation; the Missouri DNR, DEQ, Water Pollution Control Program, Laboratory Services Program, Public Drinking Water Program and Soil and Water Program. The Committee is chaired by Missouri's Clean Lakes Coordinator from the Water Pollution Control Program of DEQ.

Contact: Missouri Department of Natural Resources, Division of Environmental Quality, Water Pollution Control Program, P. O. Box 1368, 2010 Missouri Boulevard, Jefferson City, Missouri 65102, (314) 751-3241.

2. Water Development Fund. The Missouri Clean Water Commission provides moneys to match programs under such Federal agencies as the U.S. Army Corps of Engineers and the Soil Conservation Service for projects involving recreational development or water supply. No cost share limits are specified, but usually some local contribution is required.

Contact: Missouri Department of Natural Resources, Division of Environmental Quality, Clean Water Commission, 2010 Missouri Boulevard, Jefferson City, Missouri 65102.

State Level: Montana

Department of Health and Environmental Sciences

Water Quality Bureau

1. 314 Clean Lakes Program (Federal). The Bureau of Water Quality is the designated grant recipient and Clean Lakes coordinator for the State of Montana. They will be undertaking a lake classification study in 1980. No specific programs providing assistance, financial or otherwise, have yet been developed to coordinate with the Federal 314 Clean Lakes Program.

Contact: Montana Department of Health and Environmental Sciences, Water Quality Bureau, Capitol Station, Helena, Montana 59601, (406) 449-2406.

Department of Natural Resources and Conservation

1. Renewable Resource Development Program. The Department of Natural Resources and Conservation administers a loan and grant program for projects relating to the conservation, management, utilization, development or preservation of the land, water, fish, wildlife, recreational, and other renewable resources in the State. In the past, irrigation projects have been funded primarily, but more recently these moneys have been used for lake restoration projects as well. Priority goes first to the provision of loans, secondly the provision of grants to projects already receiving other assistance from sources such as Federal programs, and lastly to projects considered worthwhile but not receiving any other funding. In the latter case, assistance may be up to 100% of project costs. This program could po-

tentially be used as a match for the 314 Clean Lakes Program. Only governmental units are eligible to apply; local units must be sponsored by a State agency. \$2,000,000/year has been authorized for expenditure under this program. The Department of Natural Resources and Conservation accepts applications until July 1 of even numbered years and then makes recommendations to the State legislature for final approval and appropriation of moneys.

Contact: Montana Department of Natural Resources and Conservation, 32 South Ewing, Helena, Montana 59601.

2. Conservation District Financial Aid Program. The Department of Natural Resources and Conservation provides financial assistance through the State's conservation districts to ranchers and farmers for erosion control projects and other works of improvement for flood prevention and the conservation, development, utilization, and disposal of water within the district.

Contact: Local Conservation District Office.

Department of Community Affairs

1. Montana Coal Board Financial Aid Program. The Department of Community Affairs administers a (funding) program directly to governmental entities to assist in the alleviation of negative impacts of coal development in three counties: Treasure, Big Horn and Rosemount. Applications are presented to the seven-member Montana Coal Board for final approval.

Contact: Montana Coal Board, Department of Community Affairs, 1424 — 9th Avenue, Helena, Montana 59601.

Department of Fish, Wildlife and Parks

Parks Division: Planning and Program Administration Bureau

Applications must be submitted by November 1 annually. Grant approval decisions are made by February 1.

Contact: Montana Department of Fish, Wildlife and Parks, Parks Division, (Attention: LWCF Coordinator), Helena, Montana 59601.

State Level: Nebraska

Department of Environmental Control

Water Pollution Control Division: Water Quality Section

1. 314 Clean Lakes Program (Federal). The Water Quality Section of the Water Pollution Control Division is the agency designated to coordinate the Federal Clean Lakes Program in Nebraska. At the present time, the State has a 314-funded lake classification study underway. No financial assistance is available from the Department to match Phase 1 or Phase 2 grants; limited technical assistance and consultative service is provided.

Contact: Nebraska Department of Environmental Control, Water Pollution Control Divi-

sion, Water Quality Section, P. O. Box 94877, Statehouse Station, 301 Centennial Mall South, Lincoln, Nebraska 68509, (402) 471-2186.

Department of Natural Resources

(Water Resource and Use Planning/Non-regulatory)

1. *Natural Resources Development Fund.* Grants and loans are available to State agencies or political subdivisions having authority to develop the State's water resources. Projects must be related to the preservation and maintenance of Nebraska's water and related land resources, including programs for the abatement of pollution, reduction of flood damage, development of fish and wildlife resources, promotion of public outdoor recreational use, and the acquisition of land for these purposes. Grants may be made to political subdivisions when it is determined that such an allocation will not be reimbursed from revenue or receipts and when the program or project appears to be of general public benefit or as required to meet State matching funds for Federal grants. These moneys may provide a potential match for the Federal 314 Clean Lakes Program.

Ecological and environmental consequences of project implementation should be addressed during application.

Contact: Nebraska Department of Natural Resources, P. O. Box 94876, Statehouse Station, 301 Centennial Mall South, Lincoln, Nebraska 68509.

2. *Water Conservation Fund.* Grants are available to individual landowners for up to 75% of the total costs for implementation of eligible water conservation practices with priority being given to projects providing the greatest number of public benefits. Eligible projects include the construction of permanent water impoundment structures when drainage areas are less than two thousand acres and the construction of structures to provide temporary retention of water and sediment. Moneys are allocated to resource districts for distribution.

Contact: Local Natural Resource District or Nebraska Department of Natural Resources, P. O. Box 94876, Statehouse Station, 301 Centennial Mall South, Lincoln, Nebraska 68509.

Game and Parks Commission

The Game and Parks Commission provides technical assistance to local communities and sponsors workshops for those interested in park and recreational planning and development. They also administer the Federal Land and Water Conservation Funds from the Department of the Interior and its matching State program.

1. *Land and Water Conservation Funds.* Grants are available to incorporated political subdivisions and special purpose governmental units such as schools and natural resource districts for the acquisition and development of lands and

waters for recreational use. The State will provide up to 25% of total project costs (50% Federal, 25% local). This program is set up to specifically match the federal program of the same name. Of the moneys allocated to Nebraska by the U.S. Department of the Interior, 60% are made available to local communities (the remaining 40% being used for State projects). \$750,000 per year has been appropriated by the state legislature for use as matching funding.

Applications should be received by June 30.

Contact: Nebraska Game and Parks Commission, 2200 North 33rd Street, Lincoln, Nebraska 68503.

State Level: Nevada

Department of Conservation and Natural Resources

Division of Environmental Protection

1. *314 Clean Lakes Program (Federal).* The Division of Environmental Protection provides limited technical assistance and administrative services for the Federal 314 Clean Lakes Program. No financial assistance is available at the present time.

Contact: Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Capitol Complex, Carson City, Nevada 89710, (702) 885-4670.

Division of Forestry

1. *Reforestation Assistance.* The Division of Forestry in the Department of Conservation and Natural Resources provides at-cost plant material for soil erosion control, watershed protection and wildlife protection to both private and public landowners.

Contact: Nevada Department of Conservation and Natural Resources, Division of Forestry, Capitol Complex, Carson City, Nevada 89710.

Division of State Parks

1. *State Bonds Program.* \$5,000,000 has been authorized for the provision of grants to municipalities and counties for the development of recreational facilities including land acquisition. These funds may be used to match the Federal Land and Water Conservation Program, whereby the State will provide 25% of the total project cost, the U.S. Department of the Interior provides 50% and the local sponsor contributes 25%.

Applications must be received by June 15.

Contact: Nevada Department of Conservation and Natural Resources, Division of State Parks, Capitol Complex, Carson City, Nevada 89710.

State Level: New Hampshire

Water Supply and Pollution Control Commission

1. *Lakes Management Program.* The Water Supply and Pollution Control Commission provides

technical assistance to both private and public, profit and nonprofit organizations. They are the designated agency for coordinating both the Federal 208 Planning and 314 Clean Lakes Programs. The technical assistance that they can provide has been used to match one 314 Clean Lakes project. No State financial assistance is presently available or anticipated.

Contact: New Hampshire Water Supply and Pollution Control Commission, Concord, New Hampshire 03301, (603) 271-3503.

State Level: New Jersey

Department of Environmental Protection

Division of Water Resources

1. *Lakes Management Program*. Technical assistance in the form of intensive lake/watershed surveys, ambient monitoring, post-implementation monitoring, and guidance in applicable procedures is available and may be used as the in-kind match for the 314 Clean Lakes Program. Grants for up to 50% of the nonfederal match for Phase 1 diagnostic/feasibility studies under the 314 Clean Lakes Program (see Green Acres Program that follows for implementation projects), are also available. Eligible recipients include lake or watershed management associations, environmental commissions, State and local governmental units. To be eligible, a lake must be publicly owned and publicly accessible. \$100,000 has been authorized for 1980 Phase 1 studies. Priority ranking of public lakes, according to eutrophic conditions, will be updated each year to determine future funding allocations.

Contact: New Jersey Department of Environmental Protection, Division of Water Resources, Lakes Management Program, P. O. Box CN029, Trenton, New Jersey 08625, (609) 292-0424.

2. *Green Acres Land Acquisition and Recreation Opportunities Program*. State grants for up to 50% of project costs are available for the acquisition and development of land and water resources for recreational and conservational purposes. Included are long-term wetland management, lake restoration, specific engineering design, recreational improvements and bank stabilization projects. This program has been used to match Phase 2 implementation projects under the 314 Clean Lakes Program (up to 40% of project costs). Eligible recipients include lake or watershed management associations, environmental commissions, and State or local governmental bodies where the lake concerned is publicly owned and accessible. A priority ranking of lakes will determine funding priority. This program is used to match the Federal Land and Water Conservation Program as well (see following description).

Contact: New Jersey Department of Environmental Protection, Division of Water Resources, P. O. Box 1390, Trenton, New Jersey 08625, (609) 292-2455.

3. *Aid for Urban Environmental Concerns*. A new authorization in the New Jersey 1979 Session Laws provides grants to municipalities with populations greater than 15,000 or 10,000/square mile, where the number of ADC children exceeds 350, where there is publicly-financed housing, where the municipality's equalized tax rate exceeds the State equalized tax rate, and where the municipality's equalized valuation per capita is less than the State equalized valuation per capita. Up to \$10,000/year is available to any environmental agency to provide up to 80% of cost of projects, including the development of recreation areas.

Contact: New Jersey Department of Environmental Protection, Division of Water Resources, P. O. Box CN029, Trenton, New Jersey 08625.

4. *State Aid to Local Environmental Agencies*. Technical and grant assistance is authorized for local environmental agencies (municipal, county or soil conservation districts) to pay up to 50% of project costs (not to exceed \$2,500 per year to any one agency) for any purpose that the agency is authorized to perform by law and for the preparation of the environmental index.

Contact: New Jersey Department of Environmental Protection, Division of Water Resources P. O. Box CN029, Trenton, New Jersey 08625.

State Level: New Mexico

Department of Health and Environment

Environmental Improvement Division: Water Pollution Control Bureau

1. *314 Clean Lakes Program (Federal)*. The Water Pollution Control Bureau in the Department of Health and Environment has been given the responsibility of coordinating the 314 Clean Lakes Program for New Mexico. They are presently undertaking a classification study of five New Mexico lakes. The bureau is able to provide technical assistance as well as advisory services that would be a potential in-kind match for the initial diagnostic/feasibility portion of 314 projects. Matching moneys are not presently available but may be in the future.

Contact: New Mexico Department of Health and Environment, Environmental Improvement Division, Water Pollution Control Bureau, P. O. Box 968, Santa Fe, New Mexico 87503, (505) 827-5271.

Interstate Stream Commission

1. *Water Research Conservation and Development Fund*. \$300,000 per year is made available for projects seeking solutions to water shortage, conservation and utilization problems through research, conservation or development projects for public benefit. Public agencies, nonprofit corporations and universities are eligible to apply. No single project may receive more than 40% of the total available funds. No less than 40% of the funds are allocated for conservation or develop-

ment projects providing immediate solutions. No funds may be used for water distribution system construction.

Contact: New Mexico Interstate Stream Commission, Baltan Memorial Building, Santa Fe, New Mexico 87501.

State Level: New York

Department of Environmental Conservation
1. *314 Clean Lakes Program (Federal)*. The Department of Environmental Conservation is the designated Clean Lakes coordinating agency in New York. Classification of 800 of the State's 4,000 lakes, according to eutrophic condition, is under way. Classification is completed according to best use. No State financial assistance is presently available for lake restoration projects; matching funding has been provided by local level governments or through HUD Community Development Grants on past projects. Department regulatory permits are required when lake restoration projects impact wetlands or include dredging.

Contact: New York Department of Environmental Conservation, Division of Water, 50 Wolf Road, Albany, New York 12233, (518) 457-5447.

2. *State Aid for Comprehensive Study*. Grants may be awarded for the entire cost of preparing or updating a comprehensive study and report for present and future collection, treatment and disposal of sewage. Recently, this program has also been expanded to look at residual waste disposal and preliminary assessments of lake quality. County units of government are eligible to apply.

Contact: New York Department of Environmental Conservation, 50 Wolf Road, Albany, New York 12233, (518) 457-3495.

State Level: North Carolina

Department of Natural Resources and Community Development

Division of Environmental Management:
Water Quality Management Planning
Section

1. *Grants for Water Resource Development Projects*. The Water Quality Management Planning Section of the Division of Environmental Management in the Department of Natural Resources and Community Development has been designated as the State coordinating agency for the Federal 314 Clean Lakes Program. They provide grants to units of local government for the nonfederal share of water resource development projects. These grants could be used to match 314 Clean Lakes projects. They will cover up to 80% of the nonfederal portion of general navigation projects, up to 25% of recreational navigation projects, 66⅔% on water management (drainage) and stream restoration projects, 75% of the nonfederally-funded costs of protecting

privately-owned beaches where public access is provided, and 50% of the nonfederal portion of land acquisition and facility development of public recreation sites. Small watershed projects reviewed by the State Soil and Water Conservation Commission are not eligible.

Contact: North Carolina Department of Natural Resources and Community Development, Division of Environmental Management, Water Quality Management Planning Section, P. O. Box 27687, Raleigh, North Carolina 27611, (919) 733-6126.

Division of Environmental Management:
Environmental Planning Section

1. *County Allocation Fund*. The Environmental Planning Section allocates funds to the counties on the basis of population size for grants providing up to 25% of the cost of sewage collection systems. Applications are reviewed April 1, July 1, September 1, and January 1.

Contact: North Carolina Department of Natural Resources and Community Development, Division of Environmental Management, Environmental Planning Section, P. O. Box 27687, Raleigh, North Carolina 27611.

Soil and Water Conservation Commission

1. *Grants for Small Watershed Projects*. The Soil and Water Conservation Commission provides grants to local sponsoring organizations to apply towards the nonfederally-funded share of small watershed projects including (1) land rights acquisition for impounding or retarding water (50%), (2) engineering fees (50%), (3) anticipated future and present water supply needs in conjunction with watershed improvement works (50%), (4) installation of recreational facilities and services (50%), (5) construction costs for water management (drainage or irrigation) (66⅔%), and (6) the conservation and replacement of fish and wildlife habitat (75%). This program may not be used to match the Federal 314 Clean Lakes Program but could be coordinated with it.

Contact: North Carolina Soil and Water Conservation Commission.

County Commissioners

1. *Erosion Control Equipment*. The County Board of Commissioners is authorized to purchase equipment to be used by farmers to cultivate their lands in such a manner as may best tend to prevent erosion on the basis of resale or rental or by guaranteeing the purchase price on equipment sold directly to farmers.

Contact: Local County Board of Commissioners.

State Level: North Dakota

Department of Health

Water Supply Pollution Control Division

1. *314 Clean Lakes Program (Federal)*. The Water Supply Pollution Control Division of the De-

partment of Health is the coordinating agency for the Federal 314 Clean Lakes Program. Working with regional councils, water management boards, lake associations, and municipalities, they provide limited technical assistance in lake evaluation and the assessment of the probable causes of lake problems. They also perform a monitoring enforcement role in inspecting feedlot and sewage disposal systems.

Contact: North Dakota Department of Health, Water Supply Pollution Control Division, 1200 Missouri Avenue, Bismarck, North Dakota 58501, (701) 224-2354.

State Water Commission

1. *State Water Commission Contract Fund.* The State Water Commission is authorized to take action to conserve water levels in the State. They provide financial assistance for certain water resource projects including, but not limited to, municipal water supply, county groundwater surveys, legal drains, recreation reservoirs, multipurpose reservoirs, and flood control projects. Governmental entities, such as county water management districts, counties, cities or State agencies, are eligible to apply. The amount of funding is up to the discretion of the State Water Commission.

Contact: North Dakota State Water Commission, State Office Building, Bismarck, North Dakota 58505.

Game and Fish Department

1. *Game and Fish Department Private Land Habitat Improvement Fund.* The Game and Fish Department is developing a new cost share program that will provide financial assistance to private landowners or organizations for implementing conservation practices considered to be beneficial to fish and wildlife and the management of water quality and wetland areas. This may include the construction of sediment dams and feedlot management on private lands. This could be used to match some Federal programs in the Department of Agriculture (ASCS or ACP for example).

Contact: North Dakota Game and Fish Department, 2121 Lovett Avenue, Bismarck, North Dakota 58501.

State Level: Ohio

Ohio Environmental Protection Agency Division of Intergovernmental and Industrial Relations

1. *314 Clean Lakes Program (Federal).* The Division of Intergovernmental and Industrial Relations (DIGIR) is coordinating with the Department of Natural Resources to establish a lake priority list. At the present time, a Phase 2 project is underway in the State, and several applications for other potential projects are being processed. Local sponsors must provide the

matching moneys; OEPA and ODNR will provide technical assistance and advisory services.

Contact: Ohio Environmental Protection Agency, Division of Intergovernmental and Industrial Relations, 3rd Floor, 361 East Broad Street, Columbus, Ohio 43215, (614) 466-7220.

2. *Emergency Village Capital Improvement Rotary Fund (EVCIRF).* This fund, administered by the Division of Intergovernmental and Industrial Relations, provides financial aid to local governmental units for the preparation of preliminary or detailed engineering plans for improvements to their sewerage and public water supply system. The average \$10,000 to \$15,000 awarded to project sponsors may be used to match Step 1 and 2 of the Federal Construction Grants Program.

Contact: Ohio Environmental Protection Agency, Division of Intergovernmental and Industrial Relations, Coordinator, State, Interstate and Industrial Liaison Section, 361 East Broad Street, Columbus, Ohio 43215.

Department of Natural Resources

Division of Natural Areas and Preserves

1. *Water and Wetlands Preservation Program.* Individual landowners may receive a 50% real estate tax reduction under Ohio's Forest Tax Law if they do not develop wetlands and streams. For especially valuable natural areas, state and/or federal agencies may acquire the land directly or from other concerned interest groups such as Nature Conservancy that have acquired the land in advance.

Contact: Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Fountain Square, Columbus, Ohio 43224.

Soil and Water Conservation Districts

1. *State Aid Program.* The Department of Natural Resources provides money and reimbursements to water conservation districts for water conservation projects. \$200 is made directly available to each district each year and up to \$8,000 in reimbursements may be made to local sponsors. A local match is required but the amount is flexible dependent upon the type of projects and beneficiaries. Emphasis is given to stream protection.

Contact: Local Soil and Water Conservation District or the Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio 43224.

2. *State Cost-Share Program for Construction Improvements.* The Department of Natural Resources may cover up to 50% of the nonfederal funding share of county projects involving the construction of works of improvement for the soil and water conservation districts.

Contact: Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio 43224.

Water Development Authority

The Water Development Authority has been active in regional water planning, flood planning and conducting engineering studies, and they administer the Loan and Grant Program.

1. *Loan and Grant Program.* The Water Development Authority provides loans or grants to governmental agencies for the acquisition or construction of water management projects. Emphasis has been on wastewater management and water supply programs having beneficial use, including navigational and recreational uses of reservoirs and other impoundments. They are authorized to assist communities in issuing bonds.

Contact: Ohio Water Development Authority.

State Level: Oklahoma

Department of Pollution Control

1. *314 Clean Lakes Program (Federal).* The Department of Pollution Control has been designated as the State agency in Oklahoma to administer the Federal 314 Clean Lakes Program. At the present time, no programs are available to provide State matching funds for projects. Technical assistance is available. A classification study is underway under contract with the Oklahoma Water Resources Board. Plans are under consideration for several lake restoration projects using in-kind match of department personnel and local moneys.

Contact: Oklahoma Department of Pollution Control, N.E. 10th and Stonewall Street, P. O. Box 53504, Oklahoma City, Oklahoma 73152, (405) 271-4677.

State Level: Oregon

Department of Environmental Quality

Water Quality Division

1. *314 Clean Lakes Program (Federal).* The Department of Environmental Quality evaluated the State's lakes in terms of water quality, identifying twenty-six lakes in need of water quality improvement. Phase 1 grant applications were solicited from local sponsors on the fifteen lakes most likely to benefit from the Clean Lakes Program. The applications were rated and the top five submitted to EPA, which committed 314 funds to all five projects. At the present time, only limited matching funding is available from the State for this program.

Contact: Oregon Department of Environmental Quality, Water Quality Division, 522 S.W. Fifth Avenue, Yeon Building, Portland, Oregon 97204, (503) 229-6065.

State Park Department

Division of Parks and Recreation

1. *State Grant-in-Aid.* The Division of Parks and Recreation provides grants to governmental

units, park and recreation nonprofit districts and port districts for the development of (preferably new) park and recreational facilities. Land acquisition and park maintenance are not eligible costs. \$500,000 was authorized in 1979 for use in FY 80 and 81. Where no Federal funds are involved, the State will cost share with the local sponsor (50/50) or if the project is less than \$2,500, the State will pay up to 75% of the project costs. When used to match the Federal Land and Water Conservation Funds, the State will pay 25% (local sponsor 25%, Federal 50%) of eligible project costs.

After funds have been authorized by the State legislature (by July 4 on odd years), the Division of Parks and Recreation will solicit applications. Local sponsors are asked to express commitment to apply by October 15 and then complete applications by February 1.

Contact: Oregon State Park Department, Division of Parks and Recreation, 525 Trade Street S.E., Salem, Oregon 97310, (503) 378-6305.

State Level: Pennsylvania

Department of Environmental Resources

1. *Land and Water Conservation and Reclamation Fund.* In 1968, a \$500,000,000 bond issuance was authorized by the Pennsylvania Legislature. The \$200,000,000 portion allocated to the Department of Environmental Resources has been almost entirely spent or obligated to projects including, but not limited to, the elimination of land and water scars from past mining operations and the prevention, control and elimination of stream pollution. The \$100,000,000 portion first allocated to the Department of Health for sewage treatment facility construction is now administered by the Department of Environmental Resources. The department or other political subdivisions (counties, municipalities) are eligible to receive assistance. In the past this has been an active program in wetland management; however, very little funding remains for future projects.

Contact: Pennsylvania Department of Environmental Resources, P. O. Box 2063, Harrisburg, Pennsylvania 17120.

Division of Water Quality: Bureau of Water Quality Management

1. *314 Clean Lakes Program (Federal).* The Division of Water Quality in the Department of Environmental Resources has been designated as the agency to coordinate the Federal Clean Lakes Program in Pennsylvania. Local watershed or lake associations must initiate applications and provide the matching moneys for projects. The State only performs a reviewing role at the present time.

Contact: Pennsylvania Department of Environmental Resources, Division of Water Quality, Bureau of Water Quality Management, P. O. Box

2063, Harrisburg, Pennsylvania 17120, (717) 787-9614.

**Division of Storm Water Management:
Technical Services Section**

1. *Storm Water Management Program.* The Storm Water Management Act of 1978 requires counties to prepare watershed stormwater management plans for each designated watershed in the county, working with neighboring counties and municipalities when the watershed is of mutual concern. Plans are then reviewed by various planning agencies up to the regional planning agency and finally submitted to the Department of Environmental Resources. A public hearing is required. Municipalities are required to adopt and implement zoning, subdivision, building code, erosion and sedimentation and other ordinances consistent with the plan. The Department of Environmental Resources is authorized to administer grants up to 50% of the allowable costs of preparing the stormwater management plans. \$500,000 were authorized for FY 79. No funds, however, were authorized for FY 80. At the present time, the Department of Environmental Resources is preparing a priority list of counties based on the urgency of need for planning. Such planning will begin in counties able and willing to commit the local funding.

Contact: Pennsylvania Department of Environmental Resources, Division of Storm Water Management, Technical Services Section, P. O. Box 2357, Harrisburg, Pennsylvania 17120, (717) 787-6827.

Territory Level: Puerto Rico

Environmental Quality Board

1. *314 Clean Lakes Program (Federal).* The Environmental Quality Board is the coordinating agency for the Federal 314 Clean Lakes Program in Puerto Rico. They have completed a lake classification study and have been authorized to spend \$80,000 a year to match the Federal moneys on future 314 Clean Lakes projects.

Contact: Puerto Rico Environmental Quality Board, P. O. Box 11488, Santurce, Puerto Rico 00910, (809) 725-0717.

2. *Industrial and Environmental Pollution Control Facilities Financing Authority Loan Program.* The Environmental Quality Board administers a loan program to industrial firms for pollution control projects including, but not limited to, solid and sewage waste disposal projects.

Contact: Puerto Rico Environmental Quality Board, P. O. Box 11488, Santurce, Puerto Rico 00910.

Recreation Development Company

1. *Land and Water Conservation Fund (Federal).* The Recreation Development Company is the agency that administers the Federal Land and Water Conservation Program for park and recreational development. Commonwealth funds are

available to provide the 50% matching moneys but local communities are encouraged to provide some share as well.

Contact: Recreation Development Company, P. O. Box 2923, San Juan, Puerto Rico 00903.

State Level: Rhode Island

Department of Environmental Management

Division of Water Resources

1. *314 Clean Lakes Program (Federal).* The Division of Water Resources in the Department of Environmental Management has been authorized to cooperate with the Federal government to classify the waters of the State of Rhode Island and to develop comprehensive programs to abate and prevent pollution. At the present time, this is the designated agency to coordinate the 314 Clean Lakes Program; however, because Rhode Island has very few freshwater lakes, this program has not had high priority for State funding assistance and no projects have yet been undertaken.

Contact: Rhode Island Department of Environmental Management, Division of Water Resources, 209 Cannon Building, 75 Davis Street, Providence, Rhode Island 02908, (401) 277-2234.

Division of Parks and Recreation

1. *Recreation Development Funds.* The Division of Parks and Recreation administers the Federal Land and Water Conservation Program for park and recreational development at both the State and local levels. The Recreation Development Fund, with moneys from State beach, park and concession fees, is available to provide the 50% match in State projects only. Local communities need to provide the 50% match out of local revenues. The Division of Parks and Recreation will provide technical assistance on projects and aid in the application procedure for Federal funding.

Contact: Rhode Island Department of Environmental Management, Division of Parks and Recreation, 83 Park Street, Providence, Rhode Island 02903.

Division of Fish and Wildlife

The Division of Fish and Wildlife uses hunting and fishing license fees to match Federal programs and to run State programs relating to fish and wildlife habitat enhancement and to acquire land for these purposes. Moneys are not available for local use. This might be a potential source of matching moneys for the Federal 314 Clean Lakes Program if the project were to fit the Division of Fish and Wildlife's program requirements.

Contact: Rhode Island Department of Environmental Management, Division of Fish and Wildlife, Washington County Government Center, Wakefield, Rhode Island 02879.

Department of Administration

1. *Statewide Planning Program*. The Department of Administration is the agency involved in the 208 Planning and 303 Basin Planning processes. Although they do not have moneys for the implementation of their recommendations, they could be useful in providing technical assistance (in-kind match) for Phase 1 feasibility studies under the Federal 314 Clean Lakes Program.

Contact: Rhode Island Department of Administration, Statewide Planning Program, 265 Melrose Street, Providence, Rhode Island 02907.

State Level: South Carolina

Department of Health and Environmental Control

1. *314 Clean Lakes Program (Federal)*. The Department of Health and Environmental Control is the agency designated to administer the Federal 314 Clean Lakes Program. They are able to provide technical assistance as well as advisory services to local units of government in the application process, but matching moneys must be provided locally.

Contact: South Carolina Department of Health and Environmental Control, 2600 Bull Street, Columbia, South Carolina 29201, (803) 758-3944.

State Level: South Dakota

Department of Water and Natural Resources Office of Water Quality

1. *State Lakes Protection and Rehabilitation Grants*. The South Dakota Department of Water and Natural Resources provides grants to State and local government units for projects involved with water quality restoration and watershed control. Eligible projects include, but are not limited to, the construction of sediment traps, waterways, terraces, riprapping, the establishment of buffer zones, dredging, chemical flocculation of nutrients, lake bottom sealing, aeration, and the preparation of construction drawings, specifications, estimates and contract documents as well as the costs of project supervision and provision of materials. \$300,000 has been authorized for FY 80 to cover up to 25% of the costs of federally-funded projects and up to 60% of costs when Federal funding is not available. Grants may be up to 100% for projects on lakes which are principally surrounded by State-owned land. No more than 40% of each year's allocation may go to one project. This program may be used to match the Federal 314 Clean Lakes program if the lake under consideration is among those lakes that have been classified as fisheries and if it provides for adequate public access and use. No funds have been authorized for FY 81.

Projects must have the approval of the affected conservation district, have undergone a pub-

lic hearing and have been placed on the State's project priority list. Following final adoption of the project priority list, applicants have 60 days to apply for Federal funds.

Contact: South Dakota Department of Water and Natural Resources, Office of Water Quality, Room 413, Joe Foss Building, Pierre, South Dakota 57501, (605) 773-3351.

State Level: Tennessee

Department of Public Health

Division of Water Quality Control

1. *314 Clean Lakes Program (Federal)*. The Department of Public Health, Division of Water Quality Control, is the State coordinating agency for the Federal 314 Clean Lakes Program. They are presently involved in a classification study of Tennessee's lakes. They are able to provide advisory services for the 314 grant application process. Matching funds must be provided locally.

Contact: Tennessee Department of Public Health, Division of Water Quality Control, 621 Cordell Hull Building, Nashville, Tennessee 37219, (615) 741-2275.

State Level: Texas

Department of Water Resources

Division of Construction Grants Engineering and Water Quality Planning

1. *314 Clean Lakes Program (Federal)*. The Division of Construction Grants Engineering and Water Quality Planning in the Department of Water Resources is the agency designated to coordinate and apply for Federal 314 Clean Lakes Grants. Matching moneys for Clean Lakes projects must be provided at the local level. The department also performs a monitoring role in assessing lake quality on 102 reservoirs in the State.

Contact: Texas Department of Water Resources, Division of Construction Grants Engineering and Water Quality Planning, P. O. Box 13087, Capitol Station, Austin, Texas 78711, (512) 475-3926.

Department of Parks and Wildlife

1. *Local Parks and Recreation and Open Space Program*. A new program modeled around the same guidelines as the Land and Water Conservation Program but using State moneys instead of Federal moneys and directed specifically at projects developing park and recreational facilities in the Standard Metropolitan Statistical Area (SMSA^(e)) is being implemented at the present time. The State will provide up to 50% of the project costs. \$60,000,000 per year has been authorized by the legislature for this program for the next four years. Priority is considered in terms of how well projects meet the needs identified in the State Outdoor Recreation Plan with water-related activities having high priority.

Contact: Texas Department of Parks and Wildlife, Grants-in-Aid Branch, 4200 Smith School Row, Austin, Texas 78744.

State Level: Utah

Department of Health

Division of Environmental Health: Bureau of Water Pollution Control

1. *314 Clean Lakes Program (Federal)*. The Bureau of Water Pollution Control in the Division of Environmental Health is undertaking a classification study of Utah's freshwater lakes at the present time. They expect to be able to provide technical assistance as well as advisory services to local governmental units applying for Federal 314 Clean Lakes Grants in the future.

Contact: Utah Department of Health, Division of Environmental Health, Bureau of Water Pollution Control, P. O. Box 2500, Salt Lake City, Utah 84110, (801) 533-6146.

Department of Community Affairs

1. *Community Impact Fund*. The Department of Community Affairs has a limited amount of funding (\$2,000,000-\$3,000,000 each year) to administer as grants to local and State governmental units for studies or corrections of problems relating to community impact. Projects may include, but are not limited to, sewage and water pollution problems resulting from community location near lakes and streams. Projects may be funded up to 100%, but project size may be limited depending on available funds.

Contact: Utah Department of Community Affairs, Room 110, State Capitol, Salt Lake City, Utah 84110.

State Level: Vermont

Agency of Environmental Conservation: Department of Water Resources

Division of Water Quality

1. *Lakes and Ponds Program*. The Lakes and Ponds Program consists of three phases: 1) lakes and ponds surveillance to monitor water quality and identify lakes with water quality problems, 2) lakes and ponds studies to document in greater depth the eutrophic status of lakes selected for Phase 1 studies under the Federal 314 Clean Lakes Program, and 3) management and restorative action with the development of lake management and restoration programs including use of Phase 2 Federal Clean Lakes Implementation Grants. In-kind services have provided a partial match for two 314 Clean Lakes projects.

Contact: Vermont Agency of Environmental Conservation, Department of Water Resources, Division of Water Quality, State Office Building, Montpelier, Vermont 05602, (802) 828-2761.

2. *Aquatic Nuisance Control Program*. Technical assistance and grants-in-aid are available through this program for projects involving wa-

tershed control, in-lake control, and/or planning that emphasizes aquatic nuisance control including, but not limited to, rooted aquatic vegetation, algal populations and sediment deposits. State and local governmental units are eligible to receive aid. A local sponsor must contribute a minimum of 25% of the project costs. This program may be used to match the Federal 314 Clean Lakes Program (Phase 1 and Phase 2). A preliminary biological survey is required before release of funds.

Contact: Vermont Agency of Environmental Conservation, Department of Water Resources, Division of Water Quality, State Office Building, Montpelier, Vermont 05602, (802) 828-2761.

Department of Forest, Parks and Recreation Recreation Section

1. *State Matching Funds*. Matching funds (20-35% of project costs) are available to match Federal programs related to recreational development. State and local governmental entities are eligible.

Contact: Vermont Agency of Environmental Conservation, Department of Forest, Parks and Recreation, Recreation Section, State Office Building, Montpelier, Vermont 05602.

State Level: Virginia

State Water Control Board

Division of Ecological Studies: Bureau of Surveillance and Field Studies

1. *314 Clean Lakes Program (Federal)*. The Bureau of Surveillance and Field Studies has responsibility for coordinating the Federal 314 Clean Lakes Program. The matching moneys on projects must be provided locally. The Bureau is able to provide technical assistance and advisory services in the application process.

Contact: Virginia State Water Control Board, Division of Ecological Studies, Bureau of Surveillance and Field Studies, P. O. Box 11143, Richmond, Virginia 23230, (804) 257-0943.

Commission of Outdoor Recreation

Grants Section

1. *Virginia Outdoors Fund*. The Virginia Outdoors Fund consists of Federal moneys from the Land and Water Conservation Program and State appropriated funds when available. The Grants Section administers a reimbursable program to cover up to 50% of the costs of park and recreational facilities development including land acquisition if development is to occur at some present or future time. Sponsors (State, municipal and county governmental units and regional park authorities) must be capable of financing the project while requesting periodic reimbursement. Eligible projects must be approved by the nine-member Commission of Outdoor Recreation; priority is given to water-based acquisition projects and to those projects

that are communitywide in scope. Individual projects may range in cost from a minimum of \$25,000 to a maximum of \$500,000.

Contact: Virginia Commission of Outdoor Recreation, Grants Section, 8th and Franklin Streets, Richmond, Virginia 23219, (804) 786-1299.

Recreation Services Section

This section of the Commission of Outdoor Recreation is the advisory and consulting portion providing technical assistance to park and recreational interests.

Contact: Virginia Commission of Outdoor Recreation, Recreation Services Section, 8th and Franklin Streets, Richmond, Virginia 23219.

State Level: Washington

Department of Ecology: Water Pollution Control Agency

1. *Lake Restoration Program (Referendum 26 Funds)*. In the past this program has provided technical assistance and grants for projects involved with both point and nonpoint source watershed and in-lake pollution abatement measures. State matches (up to 40% of project costs) for lake projects funded under Section 104 (h) (research, investigations, training and information programs for lakes) of Public Law 92-500, and for sewage treatment construction grants (15%) have come from this program. For projects not qualifying for Federal moneys, the State has paid up to 50% of project costs. Emphasis now is on use of this program for waste treatment; use for lake restoration projects is being reevaluated. Local governmental units are eligible.

Contact: Washington Department of Ecology, State Water Pollution Control Agency, P. O. Box 829, Olympia, Washington 98504, (206) 753-3886.

2. *State Grant Program (Referendum 38 Funds)*. Approved by the voters in November, 1980, this new program will, over the first 2 years, phase out the Lake Restoration Program mentioned previously. Grants under this program may be used for both point and nonpoint source control and thus will be available for matching the Federal 314 Clean Lakes Program in the same manner as the previous Lake Restoration Program was used. Participation by the State of Washington in 314 Phase 1 diagnostic feasibility studies is uncertain at present, as are funding arrangements for such studies. The State does, however, intend to participate in Phase 2 implementation projects for controlling pollution entering lakes and for restoring lakes. Project costs for Phase 2 projects will be shared by the Federal 314 Program, the Washington Department of Ecology, and the local project sponsors according to a 50:40:10 ratio. However, projects receiving moneys under the Federal Sewage Treat-

ment Construction Grants Program will no longer receive State funds but will require a 25% local match. Projects not receiving Federal moneys will be funded up to 50% by the State. Project requirements for the State program will be similar to those required for the Federal program; however, the goals of the two programs may be somewhat different.

Contact: Washington Department of Ecology, State Water Pollution Control Agency, P. O. Box 829, Olympia, Washington 98504, (206) 753-3886.

Interagency Committee for Outdoor Recreation

1. *Recreation Grants-In-Aid*. The Interagency Committee for Outdoor Recreation (IAC) administers funds to eligible local and State agencies to acquire and develop parks. Funds in the Outdoor Recreation Account come from voter-approved bond issues, from Initiative 215, and from the Federal Land and Water Conservation Fund. Local agencies eligible to receive grants-in-aid include counties, municipalities, park districts, park and recreation districts, and other municipal corporations and certain Indian tribes. Local agencies generally are expected to provide 25% of total project costs.

A current comprehensive park and recreational plan and capital improvement program must be on file with IAC. IAC planning personnel are available to assist local communities in developing and updating their local plans.

Contact for planning: Washington Interagency Committee for Outdoor Recreation, Planning Services Division, 4800 Capitol Boulevard, Tumwater, Washington 98504.

Contact for grants: Washington Interagency Committee for Outdoor Recreation, Project Services Division, 4800 Capitol Boulevard, Tumwater, Washington 98504, (206) 753-7140.

Parks and Recreation Commission

1. *Parks and Recreation Consultation*. This Commission studies and appraises the parks and recreation needs of the State; consultation and advice is provided to political subdivisions and other organizations based on this information. Aid in developing recreation programs, planning park areas or facilities or in analyzing financial requirements is available.

Contact: Washington Parks and Recreation Commission, 7150 Cleanwater Lane, Thurston Airstrip Center, Olympia, Washington 98504, (206) 753-5763.

Department of Game

1. *Habitat Development Program*. Designed to develop wildlife habitat on private and public lands through a legal cooperative agreement between the landholder and the Department of Game, this program provides for shrubs, trees, grasses, legumes, and installation of watering

devices. The program, initiated at the discretion of the Washington State Department of Game, works in conjunction with the Federal Pittman-Robertson Program with emphasis on upland bird enhancement. Research and management of urban wildlife can also be provided under the nongame program including development work for vegetational and aquatic alteration favorable to birds, mammals, reptiles, amphibians, and nongame fishes.

Contact: Washington State Department of Game, Game Management Division, 600 North Capitol Way, Olympia, Washington 98504, (206) 753-5728.

State Level: West Virginia

Department of Natural Resources

Division of Water Resources

1. *314 Clean Lakes Program (Federal)*. Due to the lack of natural lakes and the absence of pollution, West Virginia is not participating in the EPA Clean Lakes Program at this time. The only large lakes in West Virginia are Corps of Engineer impoundments and they are presently monitoring and maintaining water quality in these reservoirs.

Contact: West Virginia Department of Natural Resources, Division of Water Resources, 1201 Greenbrier Street, Charleston, West Virginia 25311, (304) 348-5902.

West Virginia Water Development Authority

1. *Small Business Pollution Control Financing Program*. The West Virginia Water Development Authority (WDA), in cooperation with the U.S. Small Business Administration, is undertaking a new program to enable credit-worthy small business to finance water pollution abatement facilities. The WDA issues pollution control revenue bonds to finance the facilities which will be owned by WDA and leased to small businesses under a lease/purchase agreement. Generally, the amount of the principal, which may be guaranteed, may not exceed \$4,000,000. Repayment may be up to 25 years. Commercial banks act as sponsors of small businesses' applications for assistance.

Contact: West Virginia Water Development Authority, 1201 Dunbar Avenue, Dunbar, West Virginia 25064, (304) 348-3612.

Governor's Office of Economic and Community Development

1. *Community Partnership Grants and Loans Program*. Funded by an appropriation from the West Virginia Legislature, this program provides funds for projects having an impact on growth and economic development of a particular area and stimulating the investment of private capital. Such projects as water and sewer facilities are included. This is meant to be a secondary source of funding for projects having other primary funding sources.

Contact: West Virginia Governor's Office of Economic and Community Development, State Capitol, Charleston, West Virginia 25305.

State Level: Wisconsin

Department of Natural Resources

Office of Inland Lake Renewal

1. *Study and Implementation Grants*. These funds are available to lake districts for use in watershed control of nonpoint pollution and animal waste, streambank stabilization, in-lake treatments that are noncosmetic, and for engineering design. They could potentially be used for lake/lakeshore usage, education training and/or planning purposes but generally are not. Technical assistance on study designs, data evaluation and management options is also available. Lakes must be accessible to the general public via public lands or easement. \$1,300,000 has been authorized for FY 80. The State will pay up to 60% of studies and 80% of implementation projects; no project may receive more than 10% of available funds. Funds may be used to match with Federal Section 314, Clean Lakes funds, the local sponsor's share ranging around 20% in this case.

Grant applications for studies are filed prior to October 1 and funded by April 1. Processing time for implementation grants, for which a public hearing is required, is usually a minimum of 6 months.

Apply to: Wisconsin Department of Natural Resources, Office of Inland Lake Renewal, Box 7921, Madison, Wisconsin 53707, (600) 266-3125 or county extension agent.

2. *Wisconsin Funds*. Grant funds as well as technical assistance are available for both point and nonpoint source water pollution abatement. The State will pay up to 60% of the cost of municipal waste treatment systems not receiving Federal funds to local government units when the State assesses and determines that need is of high priority. Waste facilities (septic tanks) may be funded for private landowners where the request is made by the county. Finally, State grants up to 50% of the project cost (the local share being at least 30%) are available for implementing measures to meet nonpoint source water pollution abatement needs identified in areawide water quality management plans (during the 208 planning process) when requested by the designated management agency. Focus for this program is on providing assistance in critical geographic locations where watershed problems are most severe but control is most feasible.

Contact: Wisconsin Department of Natural Resources, Box 7921, Madison, Wisconsin 53707 or county extension agent.

Bureau of Aid Programs

1. *Outdoor Recreation Action Program*. The Lo-

cal Park Aids portion of this program allocates moneys to local county governmental units for distribution to local communities in the form of grants for the purpose of park development including park facility construction, development, and land acquisition costs. Grants may be up to 50% of project costs. \$1,000,000 was allocated to Wisconsin's counties in 1979-80 for this program.

Across the State, six community service specialists have been designated to assist local governmental units in the development of plans, application procedures, etc.

Contact: Wisconsin Department of Natural Resources, Bureau of Aid Program, Box 7921, Madison, Wisconsin 53707 for further information.

2. *Boating Recreation Program.* The State provides grants for up to 50% of project costs for the

development of boating facilities. Local governmental units are eligible to apply for assistance.

Contact: Wisconsin Department of Natural Resources, Bureau of Aid Programs, Box 7921, Madison, Wisconsin 53707.

Board of Soil and Water Conservation Districts

1. *Soil and Water Conservation — State Aid Program.* \$1,000 is made available annually to soil and water conservation districts where plans are approved by the board for the purpose of providing technical and nontechnical services, materials necessary for planning and application of conservation measures, field equipment and education materials. Project funding, up to 50% of the project cost or \$1,000 whichever is less, is possible.

Contact: Local Soil and Water Conservation District office.

APPENDIX I

CONSULTANT SELECTION PROCEDURES

Both diagnostic-feasibility studies and implementation projects vary widely in size and complexity. Some applicants have experts on staff who can undertake either Phase 1 or Phase 2 work in-house, while others may find it necessary to retain consultants. Consulting services can range from the assistance of a single expert in one aspect of a study — nonpoint source monitoring, for example — to management and execution of an entire project by an environmental consulting firm. This appendix has been included in the manual to assist recipients of cooperative agreement awards in obtaining whatever consulting services they may require.

Consultant selection should be performed in accordance with the EPA regulations published in the *Federal Register* (40 CFR Part 33) "Subagreements—Minimum Standards for Procurement Under EPA Grants." These regulations indicate that, for professional services, the selection of consultant by negotiation is recommended. Competitive bidding and formal advertising are not required in this process, but competition appropriate to the type of project work to be performed should be maximized.

The types of expertise needed for lake protection and restoration — limnology, water quality evaluations, watershed management, nonpoint source control, in-lake restoration procedures, and benefits assessment — may be found at universities, public and private research organizations, environmental consulting companies, or engineering firms. However, lake work is a specialty, and the applicant is encouraged to carefully evaluate the specific experience and exper-

tise of any consultant being considered, regardless of size or reputation.

The selection procedure, which is probably the least burdensome for the procuring agency and prospective consultants alike, begins with the issuance of a brief description of the project, the services required, and a request for statements of qualification. This procedure should result in a group of interested individuals, or organizations, which can be screened to produce a list of consultants to be invited for interviews. (Agencies with first-hand knowledge of several consultants in this field may choose to omit the request for qualifications and proceed directly to interviews.)

At the interview, as well as in reviewing statements of qualification, the specific questions which should be asked of prospective consultants include at least those listed below.

1. What is their experience in performing physical, chemical and biological lake studies?
2. What experience do they have in monitoring and analyzing nonpoint sources, including installation and operation of automated monitoring stations and stream gaging stations (see Section 10.0 of this manual)?
3. What experience do they have in analyzing dry and wet weather data along with groundwater, septic tank, dryfall and wetfall, and point source data to calculate an annual nutrient and sediment budget for a lake?

4. What experience and expertise do they have in determining and evaluating the trophic condition of lakes?
5. What experience and expertise do they have in evaluating lake response to reductions in nutrient loadings?
6. What experience do they have in evaluating and designing best management practices (including development of runoff control ordinances, etc.) and in-lake restoration methodologies?
7. What experience do they have in analyzing institutional and financial approaches for implementing proposed watershed management and in-lake restoration activities?
8. Have they had experience in cost-effectiveness analysis as a basis for public agency decision-making?
9. Are they experienced in benefits assessment, especially in water-related recreation projects?
10. Have they prepared environmental evaluations, assessments, or impact statements?
11. What experience do they have in assisting with public participation activities?
12. What knowledge of and experience with the EPA Clean Lakes Program do they have?

The applicant should request specific examples of the above experience and references to call for verification.

One particular word of caution is warranted because of the importance of state-of-the-art watershed management practices in lake protection and restoration projects. The applicant should be aware of the significant difference between traditional stormwater management (i.e., design of storm sewers based on standard engineering formulas and criteria) and the performance of nonpoint source/stormwater management studies. In general, best management practices to control nutrients and sediment in watershed management of stormwater do not necessarily include standard storm sewers.

Appendix J

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